G. R. S. IX-5]

Previous references.

1892-93
~~191~~.
(L.R.)

File No. 90.

Serial Nos. 1—22

Later references.

Vide (615'23-141) of the same file.

P-122

GENERAL AND REVENUE SECRETARIAT.

Serial Nos. 1—22

A. ~~Part~~ B for

SUBJECT.

Acquisition of lands in connection with the Malegal Water Supply project.

Tendered by Contractors

W D 33—GPB—50,000—24-7-16

DPI (10)

Paris 23rd Nov 1873

Subject

1) Subject Title Deeds certain Lands are required to carry out the work and the Resident asked our help to get them, as also to buy off the Villages which had to be removed. I promised to depute a special Officer to settle the Compensation as soon as he could send me a Map showing what was required. I added that Mr Finnemore who did the Survey was

Compensation work
so satisfactorily has
available for similar
duty as years Principal.

For that we thank
a fulfilling rule for the
Petta keep we still
thinking of getting it
from so great
distance as Alexandria?
Will Prof Ebbal
Cum Sankey* give The
Image fully we want?
The Residents select these
Questions & we
discussed them in
a general way &
the Resident Council
to have his definite
opinions himself.

* From a subsequent conversation
I find that one of the
reasons for this enquiry is that
the C & M. Station wants
to be kept for Sankey
first to disbour his mind
of this idea as unorganised
& unfounded.

Yours
Dy 6/11/93 J.S.

I said that before
ordering machinery
for Kariapatna supply
he would thoroughly
study all possible
schemes for a separate
supply of the Villa

I asked
"Can the Durbar
enter into an arrangement
for the water supply
required for the new
houses on the high
ground under Durbar
jurisdiction from Khajaka
He replied "Certainly
Yes - this is a small
matter: the Station
can supply your high
ground houses if they
may build
~~put~~ like houses within
the Station" - I said
that not but would

3 (23)

CHIEF SECY.'S DEPT.

Submitted to the Dewan

For Orders

Where is this letter?

Sd/ K.G. Bhimayya
Chitra Dt. 26th Dec 93

Brings an Intimation of the Conferring Titles of Rao Bahadur Raja Nayak from the Government

1. The Titles conferred on the Zamindars & the Inamdars have all been published in the Fasli Year Book. Is the Government likewise to publish the Titles conferred on Others?

2. The Zamindars have asked for Titles. Inamdars such as Mr Bhimayya has not. Perhaps Mr Bhimayya's letter may be forwarded to

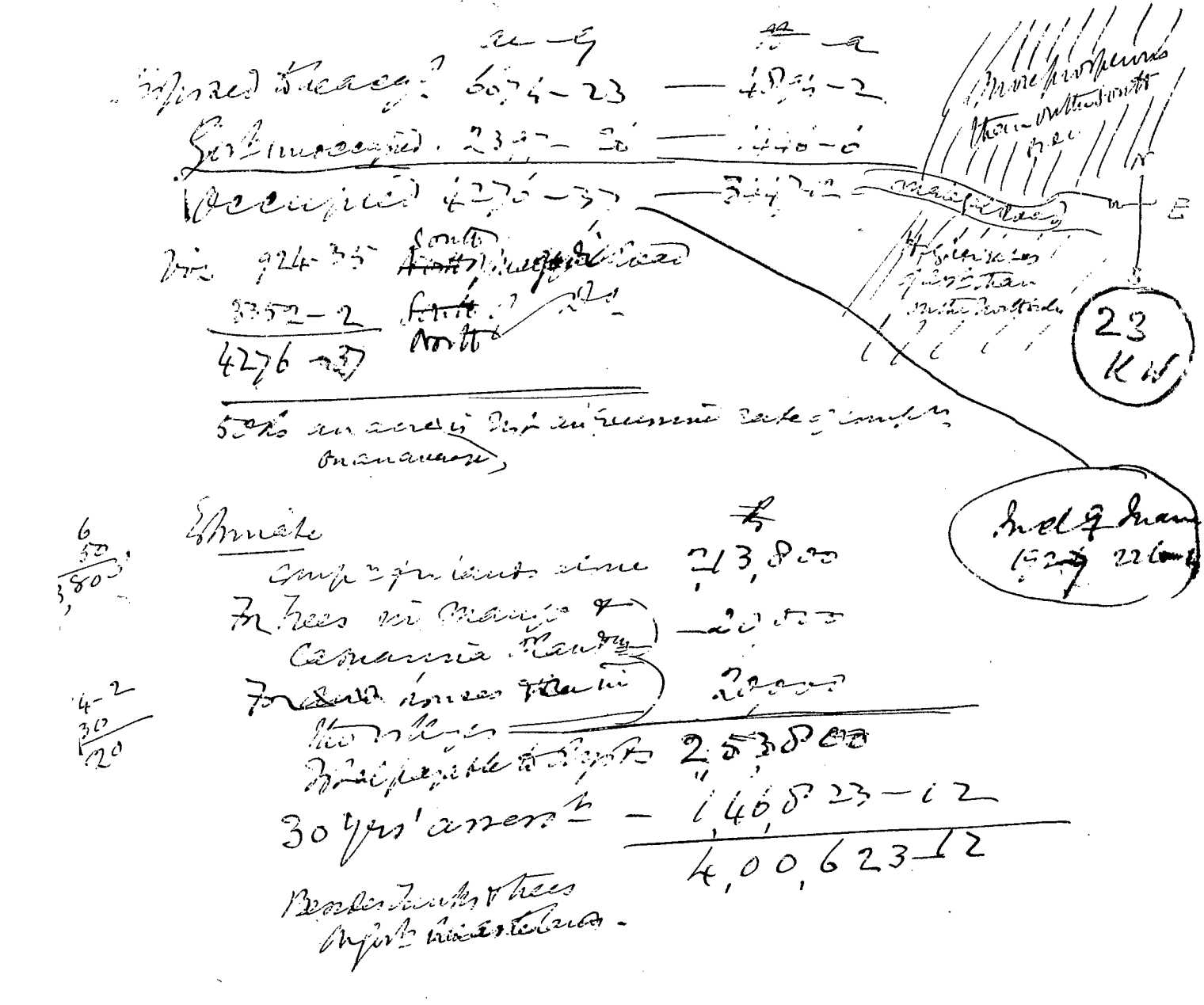
the tendency of
Assessed -

3 The [illegible]
[illegible] [illegible]
the [illegible] a [illegible]
at this rate [illegible]
[illegible] - [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
50 Rs an acre on
an average [illegible]
a fair rate - may
be taken at a moderate
rate -

Note - [illegible] has been [illegible] [illegible] [illegible] declared [illegible] [illegible] of purchase

4 [illegible] [illegible]
for appraisal [illegible]
of the value [illegible]
the population [illegible] ([illegible])
of the lands. [illegible]
[illegible] [illegible] the assessment
of these lands [illegible]
[illegible] the value in 30 years
assessment - [illegible] the
question is whether the [illegible]
had either take the [illegible]
[illegible] [illegible] or [illegible]
of annual payment
of the assessment [illegible]

[illegible] [illegible]
of [illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible] the [illegible]
[illegible] the
[illegible] [illegible]
[illegible] - [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]



Bottle Grove

Village included 13 Sixteenths
alienated
17

	Dry		Bot		Garden		Mea	
	Area	Amt	Area	Amt	Area	Amt	Area	Amt
Land								
Unoccupied	2352-6	1384-10	476	3-8	4-6	53-4	2397-20	1440-6
Occupied	4005-16	3025-14	247	8-6	24-34	15-4	4284-30	3221-8
							6452-10	4662-4
Dram								226-4
							10674 23	4884 12

North Major Road

Unoccupied lands	3352-2	2809-4
Dram	192-7	226-4
Occupied	3544-9	3035-4

Unoccupied.

4

From

Chief Secretary

To

Bangalore

Col: McNeil Campbell

India Government approved Malja
Scheme for independent supply
Civil and Military Station. Therefore
Govt requested arrange Kapparhatta
accordingly.

/Signed/

18th October
1893

L R 44/92

(Copy Noted from the Chief Engineer's Office

BS.

5.1.94.

10. *Excesses.*—The Dewan's suggestions in para .25 that the front slope of reservoir should be 2 or 3 to 1, and the top width sufficient to allow of raising hereafter another 3 or 4′, materially increases the cost. The estimate has now been entirely revised with the following constructive details, front slope 2 to 1, top of bound 13′ above weir, revetment to be 2′ thick on a good backing of jelly and gravel, and to be carried up to top of bund, with a parapet wall 2½′ high and 2′ thick along its entire length, a toe wall to be allowed throughout, top of bund to be 24′ wide and gravelled, rear slope 2 to 1 and turfed, a puddle wall to be provided throughout. These alterations, together with increased rates that it has been thought advisable to allow, as the work will have to be most carefully done, bring cost of head works up, to Rs.. 2,30,000 instead of Rs. 1,48,000, showing an increase of Rs. 82,000. The escape is of ample length, but to allow for all possible contingencies a long natural escape will be provided at the right of bund.

11. *Service Reservoir.*—It is a matter for serious consideration whether it is safe with such a great length of delivery channel to have a service reservior to contain only 3 days' supply; if a 7 days' supply is provided for, the cost will be about 2,50,000, and it is thought that this will be money well spent; this gives an excess of Rs. 1,28,000 on the former estimate.

12. *Filtering Reservoir.*—The filtering reservoir will probably cost Rs. 50,000 instead of Rs. 25,000 provided.

13. *Stand-pipe.*—The stand-pipe will cost Rs. 10,000, and owing to increase of establishment the cost of quarters for establishment may be taken at Rs. 20,000 instead of Rs. 16,000.

14. *Other items.*—The other items will remain as before, with the exception that it will be better to use Portland cement for plastering inside delivery duct and cisterns and reservoirs; this will cause an excess of about Rs. 8,000.

15. *Total cost of project.*—The savings on pipes amount of Rs. 2,92,900. The excesses are as follows:—

	Rs.
Pumps	50,000
Head works	82,000
Service Reservoir	1,28,000
Filtering Reservoir	16,000
Stand-pipe	6,500
Quarters for establishment	4,000
Other items	8,000
Total.....	2,94,500

Showing an excess of Rs. 2,500 over the original amount of the project; Rs. 31,00,000 may therefore be accepted as correct.

16. *Steel pipes.*—Since the preliminary report was written, some information has been received from firms in England regarding steel pipes which seem to show that they are preferable to cast iron pipes in every way.

The advantages claimed are—that as they require a much less thickness of metal than cast iron pipes they are much lighter and easier handled, that they can be made in 24′ or 25′ lengths instead of 12′ (the usual length for cast iron pipes), and consequently require fewer joints, and therefore there is less chance of leakage,—that they do not burst like cast iron pipes but can be easily repaired should they fail owing to excess pressure—that while in cast iron pipes flaws in casting cannot be detected in steel pipes they can be seen during manufacture—lastly, that they are cheaper. There are several different kinds of steel pipes made, the chief difference being between those welded and those revetted; the former are rather more expensive, and the latter possess the advantage of being made in greater lengths. Steel pipes being of comparatively recent introduction their

life is not known for certain. They are coated with a bituminous composition to protect them from the action of air and water, and some of them have been in use in South America for 20 years and are said to show no signs of deterioration. Fanning, in his treatise on water-supply says that 25 or 30 towns had already adopted wrought iron pipes before 1861.

The piping required for this scheme is 26,862′ of pipes 20″ diameter to withstand head of say, 400, and 18,678′ of pipes of same diameter to withstand a head of 140′; for the former pressure steel pipes should be ·250″ thick, and for the latter 128″.

In working out the exact pressures on different portions of the piping it is probable that the thickness of metal can be still reduced. The Atlas Company give the price of the thicker pipes, revetted, 25′ long with socket, as 11*s.*/10*d.* per foot, and of the lesser thickness at 7*s.*/10*d.*, so that the total cost of the piping required would be 26,862 × 11*s.*/10*d.* + 18,678 × 7*s.*/10*d.* = 4,64,144 shillings = 23,207£, which at rupees 17 to 1£ = 3,94,519 rupees.

The weight of the $\frac{1}{4}$″ pipes is 65·5 lbs. per foot, and of the $\frac{1}{8}$″ pipes 32·3 lbs.; consequently the total weight of piping would be 26,862 × 65·5 lbs. + 18,678 × 32·3 = 2,363,305 lbs. = 1,055 tons; cost of freight and carriage to Bangalore is Rs. 30 per ton or, 31,650 Rs. for the whole piping. Consequently, the cost of the steel pipes delivered in Bangalore would be Rs. 3,94,519 + Rs. 31,650 or Rs. 4,26,169, and if the same sum be allowed for valves and laying (length of pipes being more than double it will really be less) as was allowed in the case of cast iron pipes, the total cost of delivery and rising mains will be Rs. 4,80,109, or say Rs. 4,80,000, against Rs. 6,00,000, or a saving of Rs. 1,20,000. If welded pipes are used the cost will be slightly more. A further considerable reduction can be made on the cost by ordering all the pipes required at once, so that those of different diameters can be nested together and a large saving in freight thereby affected, and it is believed that the total saving on the project by using steel pipes would not be less than 2$\frac{1}{2}$ lakhs, bringing the estimate from 31 to 28$\frac{1}{2}$ lakhs.

The writer of this report has had no experience of steel pipes, and it is believed they have not yet been used in India, but the advantages of using them in this country would be very great when it is considered that the weight of 1 foot in length of a cast iron pipe 20″ to bear a pressure of a head of 400′ is 204 lbs. and the weight of 1 foot to steel pipe of the same diameter, and to bear the same pressure, is only lbs. 65·5, or 138·5, lbs. less: and as the freight is 2·6 pies per lb. the saving in freights for 1′ length is Rs. 1—14—0. The advantages of steel over cast iron pipes are given in the following statement received from the steel pipe Company:—

	Cast iron.	Mild steel.	Saving.
Internal diameter inches	24	24	
Length mile	1	1	
No. of pipes	440	220	
Weight of each pipe cwt.	24·8	10·47	
Weight of 1 mile tons	545·6	115·2	
Relative cost per ton	1	4·25	
„ of carriage per ton	1	1	
„ on total	1	·2111	78 per cent.
„ of laying per yard	1	·7	30 do
„ number of joints	1	·5	50 do
„ height of lead each joint	1	·905	9½ do
„ „ „ each mile	1	·405	59½ do
„ cost of making each joint	1	0·8	20 do
„ of jointing one mile	1	0·4	60 do
„ total for one mile	1	0·9	10 do
„ of pipes and carriage	1	0·84	16 do
„ carriage and laying	1	·834	16·6 do
Relative cost of pipes, carriage, laying, and jointing one mile	1	·788	21·2 do

From this it is reckoned that in 33$\frac{1}{2}$ years the saving in cost between steel and cast iron pipes would amount at compound interest to a sum sufficient to renew the whole line of piping.

17. *Channel from Hessarghatta to Chikbettahalli Hill.*—With reference to the proposal made by the Dewan in para 11 (2), a report by Mr. Scaldwell, Exective Engineer, is herewith enclosed, from which it will be seen that there might be a possible saving of Rs. 92,500 by having a channel direct from Hessarghatta towards Chikbettahalli Hill, and pumping the water into a reservoir on the top of that hill; but this saving will doubtless be more than counterbalanced by the increased cost of working expenses caused by having to pump a greater height through a longer rising main; the advantages also of having the pumping station near the railway line as at Banawar Hill are very great.

18. *Reduced supply with steel pipes.*—The saving that will be affected by giving the reduced supply of 10 gallons per head to 200,000 people will be very great; a 16″ steel pipe will be sufficient for rising and delivery mains, and the H. P. of the Engine required will only be 200 instead of 300. There will also be savings on other items.

19. In the preliminary report it was mentioned that no attempt had been made to work out the cost of distribution in detail, the figures entered in that report were calculated from those given by officers who had been employed on investigating the water-supply. It is certain that, owing to the scattered nature of the Cantonment, the cost of distribution to that part of Bangalore will be far greater per head than the cost of distribution to the Petta; consequently to ump the cost of the two and divide the sum to be paid by each Municipality in the proportion of the population would not be fair. It is therefore strongly recommended that the scheme should be a joint one only as far as and including the service reservoir, and the cost of the distribution be worked out separately by each Municipality.

20. *Working Expenses.*—In the preliminary report cost of fuel, &c., was entered at Rs. 20,000; this was on the assumption that wood would be got for the actual cost of growing it; if the market value of fuel is to be paid the amount allowed will have to be increased very considerably.

The H. P. of the Engine required is 300, and at least 5½ lbs. of wood will be used per H. P. per hour; this amounts to 17·7 tons per day, and at the lowest market rate Rs. 6—4—0 per ton, would cost Rs. 40,371 a year; to this should be added 16 per cent for oil, waste, and bringing the total up to Rs. 47,000.

It has been ascertained from the Forest Department that the actual cost of growing casuarina firewood is Rs. 1—0—5 per ton, the cost of sawing into billets is Re. 1, and, if the plantations are near the pumping station, carriage may be taken at As. 8, bringing total cost of fuel to say Rs. 2½ per ton. In that case the cost of fuel per annum for the 300 H. P. Engine would be Rs. 16,150 and for oil waste Rs. 3,950, total Rs. 20,000. As casuarina trees take between 10 and 15 years to reach maturity it cannot be too strongly recommended that planting trees close to the pumping station should be put in hand at once.

With reduced scheme cost of fuel, &c., would amount to Rs. 13,600.

QUALITY OF WATER.

21. In the preliminary report, para 43, the analysis of the Hessarghatta Tank as made by the Chemical Examiner, Mysore, was given, and his opinion that the water was a good potable one was quoted. Since then, Major Grant, R. E., sent some of the water from the same tank to the Chemical Examiner, Madras, and the results of his analysis are as follows:—

Total solids grammes per litre	·250
Volatile soilds do do	·090
Chlorine do do	·028
Total Hardnesss, Clark's scale	5·600
Permanent do do	1·050
Free ammonia Milli-grammes per litre	1·20
Albuminoid ammonia do do	·320
Nitric acid do do	·300

and his remarks are "*apparent quality of the water as inferred from the results obtained on examination suspicious.*" As some persons may attach undue importance to this remark, it is necessary to enter in considerable length into the question of water analysis and the purity of water.

22. It will be noticed that there is considerable difference between the analysis of the Chemical Examiner, Madras, and that of the same official in Mysore; and while the latter says the water is a good potable one the former says it is suspicious. It is quite possible that both officers are correct, as it is well known that tank water varies at different periods of the year; in fact two samples of water taken at the same time from the same part of the same tank have been found to vary considerably. *Vide* Colonel Mullin's report on the Bangalore Water-supply, the analysis of a bottle of water taken from a tank would by no means represent the average quality of the water throughout the tank all the year round.

23. Assuming that any value is to be attached to the Chemical analysis of water as regards its wholesomeness (which later on will be shown not to be the case), and taking the Madras analysis of the water, it will be found that it compares favourably with other Bangalore waters that have been pronounced usable, the only impurity in excess over one other sample being albuminoid ammonia, and this is not known to be injurious to health; in fact water containing ·80 milligrammes per litre of albuminoid ammonia was declared by the Sanitary Commissioner, Madras, to be not injurious to health in his letter No. 96, dated 31st January 1884, and Dr. M. F. Anderson, a great authority on the subject, stated in a letter to the "*Sanitary Record*" that he had never been able to obtain conclusive evidence that the dangerous elements of bad water are evolved as albuminoid ammonia.

24. That the water compares favorably with others declared by the Chemical Examiner to be usable is shown by the following table:—

	Dhobies well water.	Halsur Tank water.	Agaram Tank water.	Hessar-gatta water.
Total solids grammes per litre	·25	·31	·25	·25
Volatile solids do	·07	·08	·10	·090
Chlorine do	·042	·089	·043	·28
Total Hardness, Clark's scale	2·45	3·5	4·2	5·600
Permanent do	1·75	1·75	1·75	1·050
Free ammonia Milligrammes per litre	·24	·48	·12	·120
Albuminoid do	·4	·48	·16	·320
Nitric acid do	2·4	2·4	3·0	·300

It will be seen that the Hessarghatta water is superior to all the others except as regards hardness, and when they were classed as "*usable*" it is not clear why the Madras Chemical Examiner classed the Hessarghatta water as "*suspicious*;" the only objection is that it is a trifle hard, but the Chemical Examiner, Mysore, states that "*the total hardness is nothing like sufficient to render it unfit in any way for drinking purposes.*"

25. The analysis of the Madras Chemical Examiner is in such a form that it is somewhat difficult to compare it in detail with the analysis of water made in England, but a general comparison may be made. Put into English measure, the analysis of the Hessarghatta water is—

Total solids grains per gallon	17·51
Volatile do	6·3
Chlorine do	1·96
Total Hardness, Clark's scale	5°·6
Permanent do	1°·50
Free ammonia grains per gallon	·008
Albuminoid ammonia do	·0218
Nitric acid do	·0204

From Neville's treatise on Hydraulics the following information is taken: number of grains of solid matter contained in one gallon of the following water:—

	Grains.
Thames at Greenwich	27·9
,, London	28·0
,, Westminister	24·4
,, Twickenham	22·4
,, Leddington	17·4
New river, (London)	19·2
Lee	23·7

From this it appears that the Hessarghatta water is better than all these.

The following is taken from Fanning's treatise on water-supply :—

	Solids grains per U. S. gallon.	Hardness by Clark's scale.	Remarks.
Thames river above London	20·19	14°·5	U. S. gallon $=\frac{231}{277\cdot25}$ English gallons.
New river, (London)	16·496	14°·9	
Hessarghatta Water-supply	14·589	9°·8	

Enough has been said to show that, even if the Chemical analysis is to be regarded as of any value, the water is quite fit for drinking purposes and is far superior to many others used for that purpose.

26. At a meeting held at the Institute of Civil Engineers, on 24th January 1892, the subject of the analysis of potable water was discussed by many of the most eminent authorities, and it was generally decided that neither Chemical, nor microscopic, analysis could enable it to be ascertained whether water was wholesome or not. It will be well to quote some of the opinions given.

Mr. C. W. Folkard, A. R. S. M., says—

"Having briefly reviewed the advantages and defects of the various processes of estimating the nature and amount of the organic contaminations of potable water, it seems impossible to come to any other conclusion than that the subject is as yet beyond the scope of analytical Chemistry;"

And again—

"The present methods of water analysis are quite capable of showing if contamination has taken place at all events in the majority of cases, but whether that contamination is injurious to health or not, there is no knowledge."

Mr. Baldwin Latham, one of the greatest authorities on Sanitary Engineering, says—

"The impure water of the chemist was not always unwholesome water, nor was the pure water of the chemist always pure."

Again—

"At present if Engineers were to take the dictum of some chemists, it was quite clear that there was no water-supply fit for use."

The following quotation taken from the same authority shows how absolutely useless Chemical analysis is as a means of testing the wholesomeness of water :—

"The highest annual death rate and the highest zymotic death rate in London (1871) occurred when the impurities in the Thames and the Lee were below the average, and the waters of the deep wells were freest from impurities. The high fever death rate in 1860 occurred when the

impurities in all the sources of water-supply were below the average. The lowest death rate in London occurred in 1872, when the impurities in the Thames and Lee were above the average, and in 1880 when the death rate was low, all the sources of water-supply contained impurities in excess. The zymotic death rate of London was lowest in 1879, when all the sources of water-supply contained impurities above the average, and under similar circumstances the fever death rate was lowest in 1880. In the year 1870 the waters of the Thames and Lee contained the least amount of impurity, yet in that year the death rate was above the average. In the last three years there had been an excess of impurity in all the sources of water-suply, yet during the same period the death rate had steadily declined."

Doctor Thudichum stated—

"The analysis of water with reference to the quantity of organic matter contained in it was hygienically speaking of no value."

And again—

"Microscopic art was just as impotent as chemical art to determine whether water was wholesome or not."

Mr. Charles Ekin states as follows—

"Professor Huxley pronounced an emphatic opinion that water might be as pure as possible from a chemist's point of view and yet be most deadly."

Again—

"Mr. Ekin quite agreed with the author and Dr. Thudichum as to the little value to be attached to the determination of organic matter in water, because he had over and over again examined water that had undoubtedly given rise to typhoid fever, and found that it contained a very small amount of organic matter, and he had gone into districts where there could be no sort of contamination and examined the springs, rivers, and brooks, in which he had frequently found large amounts of organic matter that by no test could be distinguished from the organic matter in sewage."

27. It having been proved without doubt that chemical analysis is no test of the wholesomeness of water the question arises as to how the gathering ground for a water-supply is to be selected, and the common sense answer appears to be, that if the people who have been for years in the habit of drinking the water from that catchment are healthy it will be a fit source of supply. Of course, having two catchments, one cultivated and populated, and another just the reverse, both of which answer every requirement of supply, no Engineer in his senses would select the former; but supposing that the former satisfied all conditoins as to supply, cost, &c., it would be sheer folly to reject it simply because a chemist stated that the water was suspicious, when no evils had resulted to the people who had been drinking it for years. It has been shown that the sewage contamination in the Thames does not affect the health of London, which is one of the healthiest cities in the world. What harm then can possibly result from the sewage of the 700 persons residing on the Hessarghatta catchment of 7 square miles. In the former case the population is about 400 to the square mile and the sewage is discharged direct into the river; while in the latter, the population is 100 to the square mile and the sewage is more or less purified by earth before the water reaches the tank.

28. It has been mentioned in the preliminary report that the land in the catchment of Hessarghatta tank is little if at all manured, but supposing that manure is used, it is composed chiefly of cowdung with a little straw and ashes. Now, unless it is proposed to fence in the whole of the catchment and not allow cattle on it, the chief ingredient would still be deposited on the ground, the only difference being that when used as manure, it is worked into the soil and thereby purified, while in the other case the rain-fall runs directly over it into the tank. As regards decayed vegetation, it must be admitted that it is hardly possible to obtain a catchment without vegetation of any sort on it, either scrub, jungle or grass, and it is thought that as regards harmlessness the balance is in favor of decayed edible crops.

29. In the course of the debate at the Civil Engineers Institute, Mr. Baldwin Latham stated that "*he believed he should be able to show that certain Meteorological conditions were connected with every one of these epidemics which come into operation only at a particular time.*" The writer of this report is of opinion that that

Grant's Report No 2

Note on Major Grant's report on Bangalore Water-supply.

1. I have only just received Major Grant's report, dated 23rd March, on the Bangalore Water-supply, and, as I leave for England on the 5th, I shall not be able to reply so fully as I should wish.

2. Major Grant has thought it necessary to criticize the Hessarghatta Scheme in detail, though, perhaps, it would have been better if he had simply sent in his report, and allowed others to decide on the respective merits of the two projects.

3. It is much to be regretted that I had not an opportunity of seeing Generals Sandford and Lovett when they were in Bangalore, and to whom Major Grant communicated his views about the several schemes, as they would then have heard both sides of the question; this is more to be regretted now that I find I have only three days in which to reply to Major Grant's report of 50 pages.

4. Major Grant's arguments are exceedingly plausible and very well expressed, so much so in fact that, on first reading over his report, I was almost led against my own conviction to believe that in the Maligal Scheme we had at last found the only real solution of the difficulty of the water-supply to Bangalore, and that the Hessarghatta Scheme was an altogether preposterous one, had been underestimated, and prepared on wrong data; but, on going more carefully into his report, I find that many of his arguments are unsound and very much one-sided.

5. There can be no doubt that the Maligal valley water is chemically purer than that of the Hessarghatta Catchment, though experience has showed that the latter is wholesome, and quite fit for drinking purposes. The question of what scheme is to be adopted rests entirely on the supply available, and, notwithstanding all that Major Grant has said on the subject, I am still convinced that the Maligal valley will not give a sufficient supply for the whole of Bangalore in a year of deficient rain-fall. This opinion is shared by all Officers who have had long experience of the locality, and in a letter I had lately from Mr. deWinton, whose opinion Major Grant quotes freely, he stated that the Maligal Catchment was excellent as regards quality of water, but about the quantity he was more doubtful. We have had bitter experience of over-estimating the run-off in the cases of the Sankey's Tank, and the Kukkarhalli Reservoir at Mysore, and it would indeed be a calamity if, after spending 30 lakhs or so on the Maligal Scheme, it were found that Bangalore still suffered from a succession of water famines; far better would it be to spend 100 lakhs to obtain a certain supply.

6. In Major Grant's original report on the Maligal project, dated 25th April 1892, he assumed the run-off from the Maligal Catchment at 13 per cent in a bad year of 17″ rain-fall, 25 per cent in an average year of 35″ fall, and 40 per cent in a good year of 56″, and he calculated that with this run-off a sufficient supply would be obtained for 3 years for—

	Gals.	Gallons.
6,000 Europeans	12½ =	75,000
95,000 Natives	6¼ =	593,750
Total Gallons.....		668,750

or 107,000 c. ft. per day! As that run-off would not give nearly enough water for 200,000 people at 10 gallons per head, it was necessary for Major Grant either to abandon the scheme, or increase the run-off, and he preferred the latter course, believing that he was justified in doing so by the fact that the Maligal Catchment was steeper than that at Nagpur, where the run-off was found to be 19·5 per cent, for a rain-fall of 20″. Major Grant therefore assumes that the run-off will be

25 per cent in a year of 16·5″ rain-fall against his assumption in his previous report that the run-off would be 13 per cent with a fall of 17″; allowing that any comparison can be made between the Maligal and Nagpur run-offs, it seems exceedingly rash to allow a run-off of 25 per cent at Maligal with 16·5″ rain-fall, while experience has proved that at Nagpur with a rain-fall of 20″ the run-off is only 19·5″ per cent, and I am firmly convinced that with a rain-fall of 17″ evenly distributed throughout the year, the run-off at the Maligal Catchment will not exceed 13 per cent.

7. Major Grant also allows considerably less loss from evaporation and percolation than he did in his former report, the amount now entered being 16 and 10 millions c. ft. respectively against 26½ and 22 millions c. ft. Practical experience in this Province has shown that the amount of evaporation he allows is too little, and I also consider that his reasons for reducing the amount of percolation are not sound.

8. Notwithstanding the extremely favourable view of the run-off, evaporation, and percolation, Major Grant expresses doubts in several parts of his report regarding the sufficiency of supply; he states in para 8, however, that the aim should be, "not so much to carry out at once a complete scheme as to adopt one which will "be capable of extension!" Supposing this reasoning to be sound, it is surely advisable that the expenditure that may have to be incurred should be known. There can be little doubt but that the supply in the Maligal valley will be insufficient, and the Water-supply project should include the cost of extending the Catchment; to expend 30 lakhs now on a work, knowing that almost to a certainty a large sum would still have to be spent, without including the latter in the total cost, and in all calculations regarding working expenses, water rates, &c., would be sheer folly.

9. In para 87, Major Grant says that in the Hessarghatta proposals an entirely new departure is taken, and it is assumed that an area sufficient of itself cannot be obtained, and that indent must be made on a long chain of tanks lying outside of it to supplement the deficiency. In my opinion the system adopted was perfectly correct, the least possible amount of run-off was taken, and the area required to gain the desired supply was calculated, this appears to me to be much safer a method than that adopted by Major Grant, who apparently selects a catchment of a certain extent and then *assumes* a run-off sufficient to give the required supply.

10. In the latter part of Major Grant's para 87 he seems to complain that the run-off in the Hessarghatta Catchment has been taken at too low a figure, surely if this is an error, it is one on the right side. The prospects of a run-off are not exceptionally bad, no worse than at Hebbal or Rachenhalli; but as the run-off at Sankey's Catchment has reached so low a figure as 8 per cent, it was thought prudent to assume that such a low run-off was possible at Hessarghatta. The fact that the run-off from the Kakol Tank was 11 million c. ft. in a year with rain-fall below the average is beside the question, as the rain-fall was considerably more than 17″; moreover Major Grant seems to forget that the run-off depends on the character of the rain-fall. In some years with 17″ fall the run-off might be 20 per cent and in another only 8, and in the Hessarghatta Scheme, I purposely took the worst view of the case, so as to show that there was no chance of a failure, and I think it a pity that Major Grant did not do the same as regards the Maligal Scheme, and adhere to the figures given in his first report.

11. Major Grant, with what object is not apparent, argues that there is no advantage in having so large a catchment as 211 square miles, but I am not aware that any one said that there was, and it will probably be many years before more than 50 square miles are required, and this can be got not only without any engineering difficulty but without any engineering work at all.

12. Para 33 of Major Grant's report is rather puzzling; he intends apparently to give a supply of 10 gallons a head for 200,000 people, and his storage arrangements, &c., are framed on that basis, but he allows piping large enough to give a supply of 12½ gallons per head to 250,000 persons, should the demand ever

24. From a conversation I had with Major Grant last night, I gather that when he increases his catchment he intends turning the tanks into impounding reservoirs. Now supposing on the 21 square miles of extra catchment at Rachenhalli there are 6 tanks, he will have to make them all impounding reservoirs at considerable expense, or else he will have to treat the tail work as it is proposed to treat Hessarghatta at a cost of probably 2½ lakhs. The objections to having such a large number of impounding reservoirs are obvious.

25. It does not at all follow that a scheme based on a tank 4 miles distant from the site of the proposed service reservoir ought to be very much less costly than another based on a tank 11 miles from the same objective. If, as Major Grant says, "other things were equal," such would be the case, but other things are not equal, as the cost of constructing the reservoir, connecting channels, value of tanks, compensation, loss of Revenue, will be much greater in one case than in the other; however, as I have before said, I will leave this matter to be worked out by Mr. McHutchin, as I have no time to go into the details.

26. In his para (41), as well as in many others, Major Grant makes comparisons between the Hessarghatta specification and data and those of other projects, and I contend that this is absolutely and utterly absurd. As regards specifications, cannot two works be built, both of which answer the purpose required, one cheap, and the other expensive? Because Mr. DeWinton allowed a new bund for his Rachenhalli Reservoir is that any reason why I should allow a new bund for the Hessarghatta Reservoir when circumstances are quite different, the existing bund being strong, 50 feet top width in most places? Because Mr. DeWinton built his service reservoir above ground, is it necessary that I should do so, when I consider it better and cheaper to form it in cutting? Because Mr. DeWinton pointed his revetment with portland cement, is it necessary that I should do so, when I consider it contrary to sound engineering principles, and so on?

As regards data, Major Grant must know that rates depend chiefly on lead and lift, and that two precisely similar works might be constructed at different sites one costing double that of the other! The hard red murum of clayey nature, specified by Mr. DeWinton as to be used for his bank, may have had to be got from some distance, while that soil can be got close at Hessarghatta. I cannot think of anything more absurd than comparing specifications and rates in the manner Major Grant has done in order thereby apparently to raise the cost of the Hessarghatta Scheme to 50 lakhs. If I were to adopt the same course I might say that as Major Grant only makes the top of his earthen dam in the Maligal valley 5′ above water-level, a great saving could be effected in the Hessarghatta bund by adopting his specification, as I have considered it necessary to allow top of bund 13′ above F. S. L., or 8′ more.

27. As regards the details mentioned by Major Grant in his para 41 II, (*a*), Fanning, one of the greatest authorities on water-supply, gives the limiting velocity in a 24″ pipe at 5·3′ a second and in a 20″ pipe at 5′. The velocity allowed in the Hessarghatta Scheme is 3·2 a second, but supposing this ·2′ a second extra velocity to be not advisable in the pumping main, all that will be necessary is to increase the diameter of the pipes from 20″ to 22″ for a length of 1¼ miles. There is absolutely no reason why the delivery mains should be more than 20″ diameter, a pipe of this size will discharge 450′ a minute with a velocity of 3·438′ a second, the limiting velocity given by Fanning being 4·7. If continuous pumping is allowed, the size of the pipe need only be 18″; of course a 24″ pipe would require less head and velocity would be less, but a 30″ pipe would be still better in that respect, and so on; the question is, if a 20″ pipe gives the required discharge with available head and with a velocity well below the maximum, is it advisable to lay down a 24″ pipe, the difference in cost being Rs. 3,20,000? If Major Grant's method of providing for a further increase is to be adopted, all that will be necessary is to increase the height of the stand pipe by adding 37′ to the height of the latter. The 20″ pipe would then discharge 550 cubic feet a minute with a velocity of 4·2 feet a second which is still below the maximum; of course in this case pumps powerful enough to raise the water this extra height would have to be provided in the first instance.

(*b*). There is no reason why the pumping should not go on for 13½ hours, and after due consideration I have concluded that great saving will be effected by pumping 24 hours.

(*c*). The floor of the service reservoir was placed at 3,055·00, as that level will command the whole of the station within a distance of one furlong from any house, but I have since thought it better to put the level at 3,075·00.

(*d*). It was stated in my preliminary report that no attempt had been made to work out the cost of distribution, the figure given by others was adopted, that is Rs. 3½ per head ; it was known that the supply to be carried was double, but the extra cost owing to the increase in the size of pipes it was considered would be counterbalanced by the less length required for the petta which is more compact.

28. *Para* 43.—The assertion made by Major Grant that, "it is a well known "fact that a mass of water in quick motion exercises a very purifying effect," is not quite correct, as it will be seen from the discussion at a meeting at the institute of Civil Engineers, on the 24th January 1882, that the opinion of most authorities on the subject was against that theory.

29. Is it not more probable that Manchester and Liverpool are getting their supply from lakes in Cumberland because it is as cheap, or cheaper, to get it thus by gravitation, than getting it from rivers near by pumping? The question of the London Water-supply has been engaging earnest attention at Home, not only now but for years, and, as the demand is increasing, it has been proposed that the supply should be got from the highlands of Wales, or from the Cumberland Lakes, because, if the cost of supplying water from these sources is no greater than at present, it would be better to get a chemically purer supply.

30. *Para G* 47.—The information received from Nagpur that 19·5 per cent of the rain-fall of 20″ flows off the catchment area certainly does not justify Major Grant in assuming that 25 per cent of rain-fall of 16·5″ will flow off at the Maligal valley, even though the catchment is 25 per cent steeper.

31. *Para G* 56.—As already stated Major Grant's methods of increasing his catchment are not correct, he makes a channel 5′ wide to carry the drainage not only of 3 square miles belonging to the Tanniranhalli (Mattikere) tank, but also of an extra 3 square miles in another catchment, *vide* para 57. After seeing the size necessary for the catchment channels of the Sankey's tank, it is surprising how Major Grant has considered that a channel 5′ wide will be sufficient to take the discharge from an area of 6 square miles. If Major Grant intends to increase the capacity of the Tanniranhalli tank so that it will store all the water run-off the 6 square miles, and then run it gradually along his 5′ channel into the Maligal Reservoir, then that amounts to having a 5th impounding reservoir, and it will be necessary to make that reservoir safe, and perhaps carry out Mr. DeWinton's Rachenhalli Specification. The cost of this would be heavy, moreover the cost of buying up the tank, compensation that would have to be paid for the land submerged owing to increase of water spread, compensation for loss of crops under the tank, loss of Revenue, and realignment of the Railway, have all to be taken into account.

32. These remarks apply to Major Grant's para 59 as well. The mistake made seems to be that it is calculated that by making a small channel from a tank all the rain-fall due to the catchment of that tank can be secured, when really only a quantity of water equal to the capacity of that tank is obtained. It is no doubt this erroneous notion that has led Major Grant to consider it such a simple matter to connect different series of tanks with one another, while in reality it is by no means either simple or cheap. For instance, he treats it as an exceedingly easy matter to add 12 square miles of catchment to the Rachenhalli series, but the channel to take the drinage of 12 square miles would have to be very large. When the tanks are all in one series as at Hessarghatta they drain one into the other and no connecting channels are required.

33. *Paras G* 64 *to G* 66.—The cost of Major Grant's masonry dam seems reasonable, except that it is doubtful if the Hessarghatta rate for earthwork can be applied in this case ; judging from the description of the valley it will probably be

necessary to go some distance to get all the earth required; moreover, the lift is much greater. Several dams similar to those proposed have been constructed in the Province, and the cost can be approximately stated.

34. I may mention here that, judging from para 52 G, it would seem that the sites for the earthen dams have not yet been selected, nor have apparently the capacities of the reservoirs that will be formed been ascertained, and the difficulties mentioned by me in the preliminary report may therefore still exist. The objections to having 4 dams seem to me to be very great as they are four sources of danger and anxiety with the height of bund allowed by Major Grant. I am of opinion, that after a cyclone from N. E., none of his dams (except perhaps the masonry one) would be left standing. The designs, or sites, for the waste weirs have apparently not yet been settled, and this will not be altogether a simple matter; and I am of opinion that when all details are worked out, the earthen dams will be found to cost more than Rs. 3,90,000.

35. *Paras G* 74 *to G* 79.—The estimate appears to be fairly liberal and it is probable that the project will not cost more than 32 lakhs.

36. *Para G* 86.—Major Grant seems to attach great importance to the chemical purity of water, which of course shows the Hessarghatta Scheme at a disadvantage compared with the Maligal. The analysis of the water from the several tanks are so very slightly different that they do not prove much; moreover, it will certainly be found that the analysis varies. It is probable that if a little of the Hessarghatta water were sent to the chemical examiner now, the analysis would be quite different to the last. I believe the water of all these tanks have been analysed years ago, and if these analyses are compared with the ones lately taken it will be found that they vary considerably.

37. *Paras G* 87 *to G* 89.—These are chiefly a repetition of what has already been written and I have answered most of the arguments.

38. *Para G* 98.—There will be absolutely no delay in settling the compensation for the Hessarghatta Scheme, in fact the work to the reservoir will be begun in a few weeks, water-supply, or no water-supply. Where the delay will come in appears to me to be in the Maligal Scheme, as not even the exact sites for all the dams have been chosen, nor designs for the most important works such as waste weirs, water towers, &c., worked out, and this will have to be done before starting work.

39. *Paras G* 91 and *G* 92.—I consider the tables given by Major Grant as utterly useless for the reasons given in my paras 25, 26 and 27.

40. *Paras G* 93 *to* G 100.— These are more or less a repetition of what has been said before.

41. *Para G* 100.—Major Grant seems to have altogether misunderstood the Dewan's meaning, nearly all the tanks in the series above Hessarghatta may breach and no damage be done to the reservoir with the constructive details now proposed. Major Grant's idea "that the water-supply system instead of being entirely independent and complete in itself, capable of standing or liable to fall on its own merits only, would be hampered by the necessities and vicissitudes of the large chains of irrigation tanks above," is a most extraordinary one, and his meaning is very obscure. The Hessarghatta Reservoir will be quite independent of the necessities and vicissitudes of the tanks above. Major Grant makes much capital out of this remark of the Dewan's, and thinks it proves a very marked drawback to the Hessarghatta Scheme.

42. *Para G* 101.—The matter treated of in this para requires to be settled, by the British Government and the Mysore Darbar, and is no part of the business of an Engineer.

43. *Para G* 103.—Major Grant is correct on this one point in his report, and the amount I allowed for the establishment was undoubtedly too low. When writing I considered that the Municipal Engineers could both look after the general system, but I have altered my opinion and the sum of Rs. 7,000, provided by the Dewan, should be accepted.

44. *Para G.* 104—Major Grant, takes, that 15 lbs of wood is required per N. H. P, this is a very large allowance, and with modern engines 5 to 6 lbs is nearer the mark. This would reduce the cost very considerably, but still the expenses will be high till plantations have been grown near the pumping station, *vide* my supplemental report, dated 22nd March 1893; but this is only one of many cases in which he has used unsound arguments to run down the Hessarghatta Scheme.

45. Major Grant's report is very lengthy, and the same arguments are repeated so many times in different places in different forms, that it is somewhat difficult to follow his reasoning, but the conclusions I have arrived at, after studying it are,—

1st that the Maligal Catchment is quite insufficient to give the supply required for the whole of Bangalore in a year of scanty rain-fall.

2nd. That the Maligal Catchment cannot be increased by 12 square miles for 2½ lakhs of rupees, he may get the water from two or three tanks for this money, but to obtain all the rain-fall available from the 12 square miles will cost at least 15 lakhs, consequently that this sum should be added to the cost of the project bringing it up to about 47 lakhs.

3rd. That there are serious objections to having 4 reservoirs, and perhaps 3 or 4 others in outlying villages.

4th. That as the exact sites for all the earthen dams have not apparently been fixed, nor designs for the waste weirs and water towers worked out in detail, Major Grant's estimate for head works must be accepted with caution.

5th. That he cannot increase the catchment of the Rachenhalli tank either easily or cheaply, and that the cost of buying up tanks and paying compensation for land will at Rachenhalli far exceed the amount required at Hessarghatta, so that even allowing for the extra distance of the latter it will be cheaper than the former.

6th. I am still of opinion that the Hessarghatta is the only catchment within a reasonable distance from Bangalore from which an unfailing supply can be got.

7th. That the opinion of one chemist, which is contrary to that of another regarding the quality of water, should not be accepted as a reason for rejecting the project when that water is known to be wholesome.

46. Major Grant has had about six weeks in which to write his report, but yet thinks it necessary to apologize for any mistakes that may have crept into it. How much more necessary is it therefore for me to apologize for any shortcomings, as I have only had 3 days, in addition to other work, to write my answer.

47. I feel that I am placed at considerable disadvantage, as, during that 6 weeks Major Grant has had ample time to think of every conceivable argument against the Hessarghatta Scheme, even to suggesting that mills and manufactories may be built on the catchment.

48. Major Grant does not seem to see one redeeming point in the Hessarghatta Scheme, but his contentions are not sound on many matters. There are many more points in his report that I would like to have dealt with, but I think I have noticed the more important ones, and I must leave it to Mr. McHutchin to answer the rest.

49. In conclusion I would remark that it is time the discussion on Bangalore Water-supply should cease after Mr. McHutchin's note is added to this, the subject will have been thoroughly thrashed out, and all possible arguments exhausted for and against the various projects that have been proposed at different times since 1839, and all that remains now is to decide which of the two projects is to be adopted.

50. Feeling so convinced as I do, regarding the uncertainty of the supply from the Maligal valley, I cannot too strongly recommend that, should the British Government decide to adopt Major Grant's Scheme, the Mysore Darbar should at once put in hand the Hessarghatta one as a separate supply for the Pettа.

D. McNEIL CAMPBELL, Lt.-Col., R. E.;
Chief Engineer of Mysore.

Bangalore,
3rd April 1893.

Note by Mr. R. T. Scaldwell, Executive Engineer, Bangalore, on Major S. Grant's Report on the several proposed Water-supply Schemes for the Civil and Military Station and City of Bangalore, dated 5th May, 1893.

PART I.

Hebbal Scheme.

The report on this scheme is so confusing that ... with certainty the scope of the proposed extension of the projec...

2. In para 25, it is proposed to acquire as additional gathering ground the catchment area of Honnenhalli,* Rajakunte,* Timmasandra and Tarhunse tanks, measuring 5·2 square miles (see Table A) and in latter part of para 26, it is stated that this catchment area would be increased by the gathering ground (3½ square miles) above the masonry duct; yet from calculations based on the cost of the work as given in the same para, a masonry duct that would carry a run-off of 1″ per hour from only 10 acres has been provided for.

* The names of these tanks are Shinganayakanhalli and Adiganhalli. But to prevent confusion, the names given them by Major Grant will be adhered to.

3. To discharge a run-off of 1″ per hour from the combined catchment area of tanks mentioned in para 25 of Major Grant's report and that of gathering ground above the masonry duct, would require a channel with bottom width of 210 feet, flowing 6 feet* in depth, and as it is evident from the statement of cost that no such channel has been provided for, or is intended, the additional catchment area comprised in the gathering ground above the masonry duct, cannot be considered as catchment area with reference to this project; in fact to avoid serious damage to the channel, costly superpassages would have to be constructed to pass the run-off from such gathering ground across the masonry duct.

* 6 feet assumed as maximum depth as Major Grant proposes to start the channel 6 ft. below the W. W. of Rajakunte or Honnenhalli tank.

4. It being quite evident that it is not proposed to discharge the run-off from the additional catchment as received, a storage reservoir is absolutely necessary, and cost of the same and its bearing with relation to available quantity of water from the additional catchment area will now be considered. The Honnenhalli or Shinganayakanhalli tank, (Regd. No. 103, Serial No. 36 of Kadgodi Series) has a free catchment area of 2·26 square miles and total catchment of 5·2 square miles, its capacity at present weir level is 282·5 units or 73·83 M. c.ft. and capacity of three tanks above is 73 units or 19 M. c.ft. (see Statement A). With a maximum run-off of 17 M. c.ft. per square mile, the total quantity received would be 88·4 M. c.ft., and storage capacity of Honnenhalli tank would have to be increased by 14·6 M. c.ft., the cost of which would amount to upwards of Rs. 96,893 (*vide* Statement A).

5. The advantages with regard to supply accruing from the additional catchment will now be discussed. The rate (Rs. 2 per running foot) allowed for masonry channel in para 26 will certainly not admit of the construction of a channel with water way of more than 4½ square feet, and with fall (2 feet per mile) mentioned by Major Grant such a channel would discharge 500,000 c.ft. per day of 24 hours, at which rate it would take 177 days to run out the full quantity of water proposed to be stored in the Honnenhalli tank. During this time percolation and evaporation would be going on, and admitting the same loss on this score as allowed for Hessarghatta tank, which, I may here state, is a much more water-tight reservoir

than Honnenhalli, the loss during conveyance of water, inclusive of loss of 15 per cent in transit, would be 34·36 M. c.ft., and quantity delivered in Hebbal tank would be only 54·04 M. c.ft., which is virtually reducing the catchment area of 5·2 square miles to 3·18 square miles.

6. Allowing however that by means of contour channels of large section, the *whole of the run-off from this catchment was available, the total catchment area of Hebbal tank would be only 21·98, say 22, square miles, the maximum run-off from which at 17 M. c.ft. per square mile would be 374 M. c.ft., and at 7 M. c.ft. per square mile, 154 M. c.ft..

* It should here be stated that this is most unlikely, as with catchment channel 12 miles in length, with fall of 2 to 3 ft. per mile, much of the run-off must unavoidably be lost.

7. Calculating the available supply for three years as per these figures, in the same way as was done for the Hessarghatta project (*viz.*, tank full to start with and minimum rain-fall of 17 inches for two succeeding years), the result would be that at the commencement of the third year, there would be a deficit of 5·5 M. c.ft. instead of a surplus of 172 M. c.ft. as is the case in the Hessarghatta project.

8. As even under the most favorable circumstances, the run-off from the increased Hebbal catchment is insufficient, it is unnecessary to enter into details with regard to cost of project, but I would mention that the raising of the weirs of Hebbal and Honnenhalli tanks would necessitate the raising of the Bangalore-Hindupur Railway, which would prove very costly and for which as well as for cost of Honnenhalli and other tanks, no provision has been made in the estimate: I would further beg to add the following remarks with regard to paras 16,20, 26 and 29 of Major Grant's report:—

1*st*. (*Para* 16.—*Run-off*).—The percentage of run-off does not invariably increase with the rain-fall for the following reasons:—During a year of good rain-fall, the fall is generally spread over such a long period that sometimes only $\frac{2}{3}$rds of it is effective.

In 1880 with rain-fall of 39·56 inches, only 28·28 inches (not $\frac{3}{4}$ths) was effective, while in 1881 with rain-fall of 21·63 inches, 17·91 inches (over $\frac{4}{5}$ths or nearly $\frac{5}{6}$ths) was effective.

In 1888 (year mentioned by Colonel Campbell in his report on Hessarghatta project), the total rain-fall was 34·30 inches, of which quantity only 24·5 inches was effective, and of this only 15·27 inches gave an appreciable run-off, the total run-off being $\frac{1}{10}$th the rain-fall. In 1892 with rain-fall of 27·03 inches, only 16·46 inches was effective and run-off was 11·59 M. c.ft. per square mile equal to 18·5 per cent.

2*nd*. *Para* 20.—"Theorizing" cannot certainly with any justice be applied to the Hessarghatta project, as Statement E submitted with report conclusively proved that run-off of 11 M. c.ft. per square mile was correct for an average year: I would also submit that the data obtained after years of careful investigation of run-off from Sankey's reservoir can hardly be classed in such a category.

3*rd*. *Para* 26.—The actual catchment area of Honnenhalli and tanks above is 5·2 square miles and not 5 square miles as stated by Major Grant, while that of gathering ground above masonry duct, 3·12 square miles, so that compensation would have to be paid for 8·32 square miles which, as most of the land is valuable, would amount to at least 4 lakhs instead of 75,000 as assumed by Major Grant.

4*th*. *Para* 29-(3).—In para 5 of this report it has been shown that the effect of utilizing the catchment of the Honnenhalli tank, as proposed by Major Grant, is that 25 per cent of it is lost, and as further extension; north of Tarhunse, would result in a still greater loss, I think any such extension would certainly not be advisable.

A.

Statement of Tanks proposed to be acquired for additional catchment of Hebbal Tank, Register No. 46, Serial No. 62, of Kadgodi Series.

Register No.	Serial No.	Name of Tank.	Catchment area.	Water-spread at R. L. 50·00.	Water-spread at R. L. 53·00.	Capacity at 50·00 units.	Capacity at 53·00 units.	Stock value of Tank.	Number of c.yds. of water stored per rupee.
103	36	Shinganayakanhalli ...	1,450	254	356	199	282·5	10,353	264
144	34	Adiganhalli	460	22	34	7	21	2,046	31
143	33	Timmasandra ...	951	78	101	52	97	2,368	210
142	32	Tarhunse	466	33	25	14	28	2,644	51
		Total.....	3,327 or 5·2 square miles.	387	...	272	..	17,411	...

(1) Maximum run-off at 17 M. c.ft. per square mile=88·4 M. c.ft. or 338·5 units.

(2) To store maximum run-off, capacity of Shinganayakanhalli tank must be increased by 56 units which would necessitate the raising of weir $2\frac{1}{2}$ feet, and water-spread of tank would be increased by 84 acres, the compensation for which would probably amount to Rs. 5,000, as casuarina plantation will be submerged. Wet land below the four tanks measures 259 acres, the compensation for which would amount to not less than Rs. 25,900. Loss of revenue would be Rs. 1,511, which capitalized at $4\frac{1}{2}$ per cent amounts to Rs. 33,500.

(3) As the Bangalore-Hindupur Railway line passing through a portion of the bed of the tank is now only 8 feet above weir level, the raising of the weir $2\frac{1}{2}$ feet would necessitate the raising of the Railway line, the minimum cost of which would probably be Rs. 10,000.

(4) The total cost therefore of the utilization of this catchment area of 5·2 square miles would be as follows :—

	Rs.
1) Present value of four tanks	17,411
2) Cost of increasing capacity of Shinganayakanhalli tank ...	5,082
3) Compensation for land submerged by raising weir ...	5,000
4) Compensation for wet land thrown out of cultivation ...	25,900
5) Loss of revenue capitalized at $4\frac{1}{2}$ per cent on wet and dry land ...	33,500
6) Raising portion of Bangalore-Hindupur line	10,000
Total.....	96,893

PART II.

The Rachenhalli Project.

9. In para 32, it is stated that the catchment area of this tank will consist of .5 square miles of free catchment and 21 square miles of catchment of Yelahanka nd tanks above, and further that "the catchment is so very similar to that of Iebbal that it will be quite safe to assume the same run-off as in para 21 of this eport".

10. To the last assumption, I would certainly demur, as, in the first place, there is very little waste land, in the second place, the catchment generally is gently undulating ground and in the last place, there is hardly a bit of it similar to that described in para 19 (*a*) of Major Grant's report; and I would here state that it would certainly be inviting a repetition of "Sankey's folly" if any thing more than a run-off of 17 M. c.ft. per square mile was counted on in the best of years.

11. With regard to the latter part of para 32, to the effect that "it is conceivable that the Rachenhalli catchment of 15 square miles might meet the demands in a joint scheme for the water-supply of the Civil and Military Station and the Petta", I would point out that the bed of Rachenhalli tank is very much flatter than the bed of Hebbal tank, and evaporation would therefore be much greater; consequently if 22* square miles catchment area is insufficient under the most favorable circumstances for Hebbal, it is obvious that a catchment of 15 square miles will not suffice in the case of Rachenhalli.

**Vide* paras 6 and 7.

12. In para 33, Major Grant states that "if in addition to the 15 square miles, the Yelahanka tank and the catchment in its immediate vicinity, say some 4 or 5 square miles, be taken up, that would suffice for the requirements of both towns for many years to come"; but as it has already been shown in the preceding para that a catchment of 22 square miles will not suffice, it is unnecessary to enter into details to prove the fallacy of this supposition.

13. It may be said that the surplus from tanks above Yelahanka would add greatly to the supply and with reference to this I would offer the following remarks:—

There are 19 tanks situated within the so-called outlying catchment of 21 sq. miles, the combined capacity of which is *296 M. c.ft., and allowing run-off of 7, 11 and †17 M. c.ft. per square mile during bad, average and good years, the available quantity would be 357, 231, and 147 M. c.ft. respectively, which means that during a good year the catchment area equivalent to the surplus run-off would be 3·59 sq. miles; this added to the catchment area of 19 sq. miles adverted to by Major Grant gives a catchment area of 22½ sq. miles in good years and 19 sq. miles only in average and bad years.

* This figure is wrong. The capacities of the Yelahanka series down to and inclusive of Yelahanka tank only aggregate 271 M. c.ft.
W. McH.

† The run-off of 17 M. c.ft. in a good year is more than can be expected, excepting in exceptional years, few and far between.
W. McH.

14. The catchment hitherto referred to being quite inadequate, it will now be considered what the result would be of the acquisition of the whole catchment area, 36 square miles, of the Rachenhalli Sub-series, firstly with reference to supply and secondly with reference to cost:—

1*stly.*—The run-off from the 36 square miles of catchment would be (accepting the figures given in the preceding para which are those adopted for the Hessarghatta project) 612, 396 and 252 M. c.ft. respectively for good, average and bad years.

2*ndly.*—To impound the maximum run-off of 612 M. c.ft., it would be necessary to raise the waste-weir of Rachenhalli tank about 20 ft., at which level the water-spread of the tank would be approximately 1,132 acres.

3*rdly.*—Now supposing the maximum run-off to have been impounded prior to commencement of the water-supply of both Stations and the 2 following years to be years of bad rain-fall, the result is shown below, worked out on the same data as allowed for Hessarghatta project:—

			M. c.ft.
Reservoir full at commencement of water-supply to both Stations	...		612
Annual consumption	...	182	
Percolation at 15 per cent of average contents of reservoir	...	75	
Evaporation of 6 ft. per annum of mean area of water-spread	...	246	
Total.....		503	503
			109
Add quantity received during year			252
Balance at end of first year ...			361
Consumption during 2nd year...		182	
Percolation		60	
Evaporation		197	
Total.....		439	
Balance minus.....			78
Add quantity received during year ...			252
Balance at end of second year.....			*174

*With reduced supply of 10 gallons per head per day for 200,000 people, there would be a surplus of 225 M. c.ft., allowing minimum run-off of 7 M. c.ft. per square mile, but with run-off of 3·15 M. c.ft. per square mile the surplus at end of 2nd year would be reduced to 100 M. c.ft.

4thly.—With the whole of the catchment of ~~the~~ 36 sq. miles acquired, the Rachenhalli project would answer for the water-supply of both stations, provided the minimum rain-fall (7 M. c.ft. per square mile) assumed is correct; but should the yield turn out to be only 3·15 M. c.ft., per square mile, as allowed by Colonel Campbell for the Hessarghatta project, the result would be that instead of a surplus of 174 M. c.ft., there would not be any water left in tank at end of second year. With regard to the minimum run-off of 3·15 M. c.ft. per square mile, I would state that it is quite possible the run-off from the Rachenhalli catchment of 36 sqr. miles may not amount to more than this, as the data collected from the small catchment of 2¼ square miles of Sankey's tank is no criterion for calculation of yield from a large catchment like that of Rachenhalli, it being a well known fact that the rain-fall on which the filling of tanks depends is generally confined to very limited areas. The difference in rain-fall at Sankey's tank and Executive Engineer's Office is frequently from 1 to 2 inches, while on the small catchment of 2¼ square miles of Sankey's tank, the gauges kept in different parts of the gathering ground show variations of 1·83 inches.

And *5thly.*—Allowing however that the yield from the catchment area will suffice, it will be seen from the following paras that the cost would be prohibitive.

(*a*) The catchment below the Yelahanka tank, called the free catchment, is most heavily manured and it would be absolutely necessary to acquire the whole of it. The land is very valuable, and of the 15 square miles of catchment, 1·29 square miles consists of wet land the rate for which would be at least Rs. 145 per acre, while for dry land it would probably amount to Rs. 75 per acre on an average.

(*b*) The dead stock value of the 31 tanks comprising the sub-series is, as per books of this office, Rs. 1,10,000.

(*c*) The statement of assessment on the "free catchment area" has not yet been received from the Revenue Department; but it is approximately Rs. 17,378, which capitalized at 4½ per cent amounts to Rs. 3,86,200.

(*d*). Of the outlying catchment of 21 square miles, nearly 1 square mile consists of wet and garden land which must of course be bought up, and if the tanks are breached, it will probably be necessary to resume at least $\frac{1}{3}$* of the area of dry land as no water will be available for man or beast.

* It should be noted here that to secure any prospect of run-off like that from Sankey's catchment, the whole area of 21 square miles must be purchased.

And (*e*). Calculating the compensation which will have to be paid in accordance with the above, it amounts to Rs. 17,67,170, as per details given below, whereas Major Grant has allowed only Rs. 7 * lakhs on this account and his estimate of $20\frac{1}{4}$ lakhs must be increased by $15\frac{1}{4}$ lakhs :—

* 7 lakhs stated to be probable amount of compensation in para 33 of report, but only $2\frac{1}{4}$ lakhs allowed in his abstract estimate given on page 41 of report.

Free Catchment.

823 acres of wet land at 145 per acre ...	...	...	=1,19,770
8,768 acres of dry land at 75 per acre ...	...	...	=6,57,600
Assessment of Rs. 17,378 capitalized at $4\frac{1}{2}$ per cent ...		...	=3,86,200

Outlying Catchment.

570 acres of wet and garden land at Rs. 100	...	...	57,000
4,480 acres of dry land at Rs. 50 ..	...	...	2,24,000
Assessment of Rs. 9,570 capitalized at $4\frac{1}{2}$ per cent	...	...	2,12,600
Dead stock value of 31 tanks... ...	...	...	1,10,000
		Total Rs.....	17,67,170 *

* If to this is added the compensation, &c., for the remaining 13 square miles of land, the amount must be increased by 6·93 lakhs.

15. It is very probable, it may be said, that judging from the analysis of water and reasoning from analogy, it is not necessary to throw dry land out of cultivation in the Rachenhalli catchment, if such a proceeding is not essential in the Hessarghatta catchment. With reference to this, I would state that the analysis of water is most misleading ; an inspection of both catchments while the land is under cultivation would convince any one that if the water in Hessarghatta tank is " suspicious " that in Rachenhalli is noxious, and I am sure quite a different result would be obtained from the analysis of water taken from the tanks in June or July, the Rachenhalli catchment below Yelahanka being, as already stated, the most heavily manured land in the Province. In the case of Hessarghatta, it is quite different. It will be seen from statement A submitted with that project, that notwithstanding ample water is available only $\frac{1}{4}$th to $\frac{1}{3}$rd of the land is under cultivation, which is due to manure not being available and to insufficiency of population, as statement given in page 30, of report on the Hessarghatta scheme will show.

16. With regard to resumption of dry land in outlying catchment, I have already given reasons for the same in para 14 (5) of this report and would simply invite attention to the Topographical Survey Map showing both catchment areas, from which it will be at once seen what a vastly different matter it is to take up 8 tanks situated within an area of 10 square miles with numerous adjacent tanks, to taking up 31 tanks within an area of 30 square miles with only half a dozen tanks situated within a mile of the water-shed or three miles from the centre of the valley.

17. On page 41 Major Grant gives the cost of bund and waste-weirs, according to the Hessarghatta data and specification, as Rs. 1,50,000. I have had longitudinal and cross sections of the bund of Rachenhalli tank taken and find the actual estimated cost of a storage reservior to impound 612 M. c.ft., (the quantity of water proposed to be stored at Hessarghatta is 880 M. c. ft.) amounts to Rs. 2,05,959.

PART III.

HESSARGHATTA PROJECT.

18. Colonel Campbell has so clearly shown the fallacy of Major Grant's criticism of his Project, that any further elucidation of the matter in this respect is unnecessary. I would however beg to offer the following remarks with regard to points referred to in the undermentioned paras :—

(1). *Para* 40. (*a*) It is misleading to quote the statement of rain-fall in Hessarghatta report in the sense given by Major Grant, as it was distinctly mentioned in the statement that the return of three stations were incomplete and untrustworthy. There was no assumption in the report on Hessarghatta Project that a catchment of 30 square miles would suffice " for the effective supply of 2,00,000 people". In para 45 of that report it was stated that the catchment of 30 square miles " would not half fill the impounding tanks in ordinary years " and it was further clearly shown that the project mainly depended on the surplus available from tanks above, with regard to the sufficiency of which there could be no question (see Statement E).

(*b*). The cost of the catchment area (36 square miles) of the Rachenhalli subseries has been carefully discussed in para 14 (5) and shown to be prohibitive with regard to the Rachenhalli project and I would submit that it is therefore unnecessary to consider the further extension of gathering ground that can be effected by acquisition of Hebbal and Nagavaram catchments, and failure of tunnelling to increase the supply to an extent proportionate to the drainage area and expenditure has been shown in para 5.

(*c*) The advantage of Hessarghatta over Rachenhalli is that no further extension of catchment will ever be necessary, whereas in the case of Rachenhalli it would be immediately so : and cost of acquisition of 50 square miles can be gathered from that given in para 14 (5) for 23 square miles.

(*d*) With regard to construction of mills and manufactories on the upper portion of Hessarghatta catchment area, I would simply request perusal of para 21 of Colonel Campbell's Note on Major Grant's report.

(*e*) Major Grant writes " Practically there is no difference in the circumstances of a water-supply based on the Rachenhalli series and of one starting from Hessarghatta". There is, I consider, practically a very great difference, which the annexed statement will, I think, prove :—

Hessarghatta.	**Rachenhalli.**
Condition of catchment.	*Condition of catchment.*
Sparsely populated and only $\frac{1}{4}$th to $\frac{1}{3}$rd of wet land cultivated and dry land so slightly manured as to render its acquisition unnecessary. Land of ordinary value.	Densely populated for Mysore. The whole of the wet land under cultivation and dry land more heavily manured than in any other part of the Province, in fact to such an extent below Yelahanka as to make it absolutely necessary to throw it out of cultivation. Land the most valuable in the Province.
Extent of catchment.	*Extent of catchment.*
Practically unlimited and extension beyond the 30 square miles now proposed will probably never be necessary, as gauge readings taken in March and April show a daily influx of 600,000 c.ft.	Limited to 36 square miles of natural catchment, and extension which would certainly sooner or later be necessary only feasible at an enormous cost.

Hessarghatta.	Rachenhalli.
Tanks comprised in project situated at short distances apart and proximity of other tanks such as to render it unnecessary to throw land out of cultivation owing to want of water.	Tanks comprised in project scattered, and there not being any other tanks in the vicinity, it becomes necessary to acquire land, solely, because water would not be available within a reasonable distance.
Reservoir.	*Reservoir.*
Bund strong and water tight with top width of 50 feet.	Bund weak and leaky with top width of 8 feet.

(2) *Para* 41.—Other things are, I would submit, most unequal. Many essential points of difference have already been pointed out and in para 14 (5) it has been shown that the cost of the Rachenhalli project, even on what Major Grant styles "the Hessarghatta data and specification", would cost $43\frac{1}{3}$ lakhs instead of $20\frac{1}{4}$ lakhs as stated in Report.

With regard to "precautions to insure a water tight earthen dam," I would here mention that all necessary precautions have been taken, and difference of cost is due to there being in the case of Hessarghatta a good massive dam to work on, whereas in the case of Rachenhalli it is quite the reverse, as is evident from Mr. deWinton having considered the existing bund so leaky and worthless as to make its inclusion in the new dam inadmissible.

(3) *Para* 41.—II.*d*. The cost of distribution has not, so far as I am aware, been worked out for any project, and with reference to Major Grant's objections that the "rate for distribution heretofore has been entered at from $3\frac{1}{2}$ to 4 rupees per head, the allowance being $6\frac{1}{4}$ gallons per day." "And in the Hessarghatta project, the rate is kept the same while the amount to be carried is double", I would state that in Madras, where the supply is much greater than proposed in the Hessarghatta project, and head not to be compared with that given by construction of service reservoir on Mantapam Hill, the rate for distribution is Rs. 5 per head, and from calculations I made some years ago for water-supply of a portion of Bangalore City, I am of opinion that, considering the Native quarters in both stations are densely populated and Natives form the bulk of the population to be served, the average rate of Rs. $3\frac{1}{2}$ per head entered in the Hessarghatta project will prove sufficient.

(4) *Para* 41.—III. In the Hebbal and Rachenhalli projects, it is absolutely necessary to buy up the catchments, as being situated so close to Bangalore, where any quantity of manure (most of it of the worst possible kind to put on a water-supply catchment) is available at a trifling cost; these catchments are so heavily manured that unless they were thrown out of cultivation, the run-off at certain seasons of the year would be noxious to human life. In the Hessarghatta project, matters in this respect are on quite a different footing and all that was necessary to insure purity of supply was to buy up all wet cultivation draining directly into Hessarghatta tank, which has been provided for.

(5) *Paras* 41—*III*.—As no details are given, it is impossible to ascertain how the result that the Hessarghatta project would cost over "50 lakhs," if carried out "on lines hitherto accepted at Rachenhalli," has been arrived at. In the Preliminary report all possible care was taken to ~~have~~ a workable margin on all sub-heads of work and the only alteration in estimate I consider necessary is that cost of pumps and engines should be increased by Rs. 1,12,000; but against this a saving of Rs. 1,54,836 would be effected by use of steel pipes.

(6) *Para* 42.—With regard to this para I annex the analysis of water as given in the Madras Government papers on Water-Supply of Bangalore, pages 122 and 123, to which I append an extract from page 216 of the same papers with reference to "Water pronounced *bad* not being necessarily injurious."

Analysis of Water.

Pages 122 *and* 123.—Madras Government Papers on Water-supply of Bangalore :—

	Maligal Water		Sample of water taken from Agram tank (p. 123).	Sample taken from Hessarghatta tank.	Sample taken from Miller's No. 4 Reservoir.
Total solids	... 0·423 ...	Grms. per litre	0·25	0·25	0·25
Volatile solids	... 0·100 ...	Do ..	0·10	0·09	0·08
Chlorine ...	... 0·088 ...	Do ...	0·043	0·028	0·039
Total hardness	... 7 ...	Clark's Scale	4·2	5·6	3·15
Permanent hardness	... 0·350 ...	Do ...	1·75	1·05	1·75
Free Ammonia	... 040 ...	Grms. per litre	0·12	0·12	0·20
Albumenoid Ammonia	... 0·08 ...	Do ..	0·16	0·32	0·40
Nitric acid	... 1·24 ...	Do (as Ammonia)	3·00	0·30	2·10
Apparent quality of water as inferred from the results obtained on examination			Usable.	Suspicious.	Usable.

Extract from page 216 of Madras Government Papers on Water-supply of Bangalore.

"Water pronounced bad not necessarily injurious." "No Chemist can authoritatively pronounce that a water is unwholesome; all he can do is, having fixed on a standard of purity, to say that waters submitted to him for analysis depart in certain respects from that ideal standard." "Mr. Ekin (Analytical Chemist) quite agreed with the author and Doctor Thundichum as to the little value to be attached to the determination of organic matter in water, because he had over and over again examined water that had undoubtedly given rise to typhoid fever and found that it contained a very small amount of organic matter, and he had gone into Districts where there could be no sort of contamination and examined the springs, rivers and brooks in which he had frequently found a large amount of organic matter that by no test could be distinguished from the organic matter in sewage." "The existence of an infectious property in water cannot be proved by chemical analysis." "The various processes of water analysis had one and all been shown on chemical grounds to be worthless and he had endeavoured to prove that they were worthless (as far as the power of indicating wholesomeness was concerned) by reasoning which required no technical knowledge to follow it."

"Professor Tyndall agreed with Doctor Thundichum that chemical analysis would afford but little information as to the deadliest things that might be in the water."

PART IV.

The Maligal Valley Project.

19. From para 45 to para 48 of Major Grant's report is simply "theorizing" with reference to rain-fall and run-off. That "there have been frequent pools of water on the surface of the sand," or that "water has been obtainable by scratching holes in the sand," gives no idea of the quantity of water available from springs, any more than the fact of "clear traces of a run-off being visible after a shower of 15 cents at Alsur Rock" proves anything definite with regard to quantity of run-off. Neither does the fact of there having been a flood in the Maligal Nala 6½ ft. in depth on the 26th August, when there was a rain-fall of 2·68 inches at Hebbal, in any way prove that the run-off was ⅔ths of a fall of 3″ distributed over 6 hours, the essential information on which the accuracy or otherwise of such a calculation could be ascertained being wanting.

20. I know the Maligal catchment area well, and consider it quite possible that the run-off may be double that in the Sankey's catchment, but it does not follow

that the total run-off from 10 sq. miles would be ten times that from 2 sq. miles of Sankey's catchment—it being a well known fact that increase of catchment is not proportionate to increase in quantity of water received, the reason of which is fully explained in para 14 of this report.

21. In 1887-88 a tank was constructed for the water-supply of the Bangalore Distillery below a catchment very similar to that of Magadi Valley, and not far from it, and judging from the run-off from that catchment, I feel certain that a water-supply project based on run-off per sq. mile of 10-28 and 46 M. c.ft. in years of bad, average and good rain-fall respectively would prove a failure.

22. With reference to para 49, there is no doubt that by this time Major Grant is aware of the incorrectness of Captain Ward's table of loss due to evaporation in Hebbal tank: the sluices of this tank were closed on the 12th December 1892 and notwithstanding, a small supply was received from the Kodihalli tank, situated immediately above, there has been a steady average fall of $\frac{1}{6}$th inch per day, although there has been almost an entire absence of the high winds which prevail in March and April.

23. As stated in para 20, I am well acquainted with the Maligal Valley, and am sure that it will be found very much more difficult to construct a water-tight reservoir at all four sites mentioned in the Magadi Valley than at either Hebbal or Rachenhalli, and granting this and considering the pressure due to greatly increased depth of water, I am certain the loss through percolation will be greater at Maligal than at either of the latter places, and quantity should be increased, instead of decreased 50 per cent, as done by Major Grant (*vide* para 50 of report).

24. The Maligal Valley project as now proposed by Major Grant consists of 4 reservoirs "each with an average water-spread at full tank level of about 124 acres, and a capacity of about 100 to 108 M. c. ft."

25. To fill these 4 reservoirs Major Grant has assumed a run-off 2½ times greater than the maximum hitherto allowed. No valid reasons are given for this and I would submit that in the absence of reliable data for such assumption, it should not be accepted, especially, as well established experience is against it, and a second Sankey's folly would indeed be a disaster.

26. With even double the maximum run-off hitherto allowed, only three out of the four reservoirs would fill, and allowing that the maximum, average and minimum run-off from the Magadi catchment is double that from Sankey's catchment (against which I must most earnestly protest) and accepting Major Grant's figures for consumption, evaporation and percolation, the result at end of five years would be a deficit of 45 M. c. ft.

27. The increased catchment proposed in para 55 consists of 3 square miles of * Tanniranhalli drainage, 3 square miles of Hebbal drainage, proposed apparently to be stored in Tanniranhalli tank, and 4 square miles of Hallal and Malathalli drainage to the south-west of Nagarbhavi. From levels given in the margin, it will be seen that the capacity of Tanniranhalli tank cannot be increased without raising both Bangalore-Hindupur and Bangalore-Harihar lines of Railway, and as cost of this would be prohibitive, the advantages to be gained from the extra catchment of this tank would be the supply of 15 M. c. ft. minus 2 M. c. ft. lost in transit.

*Mattikere tank, Registered No. 34, S. No. 56.
Area under cultivation 112 acres,
And approximate revenue Rs. 600.
Catchment area 1,924 acres.
Water-spread 106 do
Capacity 59 units =15 M. c ft.
Dead Stock Value ... Rs. 6,024.
Waste Weir ... 2,962·74.
Sluice ... 2,956·29.
Floor of the Railway culvert ... 2,961·13.
Bangalore-Hindupur Railway Line ... 2,966·73 and 2968·33
Bangalore-Harihar Railway Line ... 2,970·37.
and Saddle 2,976·43.

mentioned in para 18 (*d*) cannot detect the existence of infectious matter in water, but, could this be done and water taken from Rachenhalli in June and July were analysed, the result would be very different from that assumed by Major Grant.

(4) *Para* 87.—Allowing the run-off hitherto accepted, a free catchment area, entirely uncultivated, of 36 square miles is requisite to insure a reliable supply, and this cannot be had in the vicinity of Bangalore except at a prohibitive cost. The only project at all within the means of both stations is the Hessarghatta one, and the reason for its being so, is the advantages it has above all others of not requiring an extensive or expensive catchment.

(5) *Para* 87.—It is true that a population of 100,000 has existed on the water procured from the catchment area of 8 to 9 square miles and from numerous wells, but it has been a most unenviable existence for the poorer classes and so disastrous to life that a project based on this assumption is likely to meet with very scant favor.

(6) *Paras* 88 *to* 90.—The great difference in cost between Rachenhalli and Hessarghatta has been clearly explained in paras 14 (4), 15, 17 and 18 of this report, from which it will be seen that this is not due to neglect of sanitary measures for proper conservancy of water or to cheapness of specification, as the Rachenhalli dam works out Rs. 55,959 in excess, and 3 dams in Maligal Valley at Rs. 1,23,000 in excess of amounts quoted by Major Grant, when calculated on the so frequently quoted "Hessarghatta data and specification."

And (7) *Para* 91.—The abstract referred to here has been shown to be seriously incorrect (*vide* para 35 of this report).

BANGALORE,
5th May 1893.

J. SCALDWELL,
Executive Engineer,
Bangalore Division.

Mysore Govt. Central Press, Bangalore.—25-5-93.—50.

(4) 7

NOTE ON THE REPORT

BY

MAJOR S. GRANT, R. E.,

ON THE SEVERAL SCHEMES FOR THE

WATER SUPPLY

OF

BANGALORE.

by Mr. Mc Hutchin

Note on the Report by Major S. Grant, R. E., on the several schemes for the Water Supply of Bangalore.

PART I, GENERAL.

This Report is of considerable length, and many of Major Grant's remarks and arguments are repeated in it several times over; it is, however, more convenient for reference and comparison to answer his arguments paragraph by paragraph.

Paras 1 *to* 7.—Preliminary and call for no remarks.

Para 8.—The first two "Conditions for a successful Water Supply", laid down by Major Grant should, in my opinion, be taken together; for it is absolutely essential that any scheme we may adopt for a Water Supply should be capable of giving the required quantity of good wholesome water, especially in years of deficient rain-fall when other existing sources of supply are liable to fail; and if the choice should lie between a perfectly certain supply of good potable water, which has already been used by people and proved to be wholesome (even before any attempt had been made to render it chemically purer), and an uncertain and limited supply of chemically purer water, the former should in my opinion be accepted.

In this connection of the purity of potable waters, I would refer you to Colonel McNeil Campbell's Supplementary Report on the Hessarghatta Scheme, and will only add the following further remarks.

It is a perfectly known fact that a chemically pure water is not necessarily the best potable water.

It would appear from Appendices to Colonel Mullin's Report that the sample of water taken from the Alsur tank, even after passing through the filter beds, was much more chemically impure than the water now in the Hessarghatta tank, and the latter should be much purer when the weirs are raised 15 feet, area of waterspread increased to nearly $2\frac{3}{4}$ square miles, and capacity increased from $70\frac{1}{2}$ M. c.ft. to 767 M.c.ft.

Dr. Nicholson, an authority it is believed on the subject, proposed utilizing the Dhoby's wells below the Alsur tank as the best source of supply to the troops a few years ago.

As mentioned by Colonel McNeil Campbell, several of the samples of water given in the Tables in Appendix to Colonel Mullin's Report are classed as *usable* which are apparently much more chemically impure than the samples of Hessarghatta water. *Vide* Appendices, 26 C, 26 E.

The Special Committee consisting of the late Sir Oliver St. John, Colonel Bowen, R. E., and Colonel Tomkins, R. E., appointed by the Government of India to decide "*finally*" on the best scheme for a Water Supply to the Cantonment, selected the Rachenhalli tank, and this source is certainly not purer than that at Hessarghatta: it stands to reason that it cannot be so pure, the population and number of cattle on the catchment is greater, the area of cultivation larger, and the land is much more highly manured; and in the immediate vicinity of the proposed Reservoir, a large quantity of night soil from Bangalore is used.

That there is really any great harm in having dry-crop cultivation (not highly manured) on a catchment, but some distance away from the immediate vicinity of the waterspread of a tank, I do not think, has ever been proved.

Mr. Larminie in his report accompanying his estimate for the Water-supply scheme at Rachenhalli, page 12, para (*e*), says regarding Hessarghatta; "It "is thought that the objection to the impurity of the catchment is not a very "serious one; the table of analysis shows the water to be good."

The analysis of a sample of water taken from the same spot in a tank would vary at different times, and a bottle of water from one spot in a tank would be no test of the quantity of all the water in a large tank at all.

In a D. O. to Colonel Bowen, dated 1st November 1890 (in the File), the late Sir Oliver St. John stated, "*that any arguments that he (Mr. DeWinton) put "forward in favor of the Magadi Road (Maligal?) Scheme founded on a joint "supply for the Petta and Civil and Military Station, or on the comparative "purity of the respective sources, would not be taken into consideration; those "points having already been discussed and finally disposed of.*"

After such a statement as this by the President of a Committee specially appointed to argue the whole question out, why has the Maligal Scheme been brought forward again as a joint scheme? The Director General, Military Works, himself, in his No. 83, dated 7th January 1890, to the Chief Engineer, Madras Command, deprecated "the re-opening of the subject of the rival "Schemes of Maligal *Versus* Rachenhalli and Mr. DeWinton's action in com- "municating views of his own to the Local papers after the Committee appointed "by the Government of India had discussed the question in all its bearings"!

It may be inferred from the extract from Sir Oliver St. John's letter already quoted, that the Maligal Scheme had been discussed by this Committee as to its capabilities for a joint scheme and the supply found to be deficient; and it will be shown further on that the required supply of 2,000,000 gallons a day cannot be obtained from the catchment.

Major Grant's 3rd condition for a successful Water-Supply is plausible enough to read, but not, I think, sound in argument. He practically advocates that we should carry out his Maligal Scheme, and wait for a water-famine to test its incapacity to give the required supply. We are to do this with our eyes shut to all previous experience, and dismiss as useless the opinions formed by officers who have been in Mysore for the last 20 to 30 years, and accept his opinion instead! We are to do this without knowing beforehand what the extensions of catchment for supplementing the supply from several outlying valleys are going to cost; for Major Grant only estimates for bringing in 12 square miles, and if these are found to be insufficient (and it will be shown later on that the 12 square miles, thus brought in, are insufficient) what are our further extensions, even if feasible, going to cost? Major Grant's proposals for extensions of catchments are, it appears to me, based on entirely erroneous premises and, moreover, necessitate the construction of several outlying reservoirs and long lines of channels; his estimate for these are also incorrect. He has also not estimated the annual cost of maintaining his Impounding Reservoirs, channels and keeping them in order. Surely the risk of having 4 Impounding Reservoirs is sufficient to condemn any water-supply scheme without going to the length of making 3 or 4 more, especially as 3 of them, in which $\frac{3}{4}$ths of our assumed supply is to be impounded, are to be placed in a valley in which I would be sorry to build an earthen dam at all without going to a much greater outlay than has been estimated for to secure my foundations. It would be very different at Hessarghatta where the safety of our one impounding reservoir can be depended upon with as much certainty as any tank constructed by human agency can be. If a catastrophe should occur some of the 170 and odd tanks above could be temporarily acquired, and water run down into our settling tanks for our supply, until repairs were carried out.

Again, as regards "the costly dislocations of the main features of any "scheme," such would not occur at all if we provided in our scheme for probable future requirements, and the mere fact of providing a pipe of a larger diameter than necessary for our Rising Main would not render it unnecessary to (1) increase our catchment area, (2) enlarge our Impounding Reservoirs (3) renew our Distribution pipes with others of larger diameter, and (4) increas

the number or size of our Filtering and Service Reservoirs. In Major Grant's Maligal Scheme (1) cannot be done at any reasonable outlay and (2) cannot be done at all, for when the 4 reservoirs in the Maligal Valley are full, the waterspread, it is stated (para 66), will extend from end to end of the valley!

Para 9.—Requires no remarks.

PART II.

The Hebbal Scheme.

Paras 10 *to* 15.—Call for no remarks.

Para 16.—One or two points in this paragraph may be noticed. It by no means follows that the "*percentage*" of run-off in a bad year of 17″ rain-fall should *never* be greater than in an average year of 35″ rain-fall! In a bad year the monsoon rains may fail, but there may be a few heavy local thunder-storms which give a very good "*percentage*" of run-off; in a year when there is good light monsoon *rain there may be no heavy tank-filling rain at all and the "*percentage*" of run-off in the latter would of course be much less.

*For instance at Sankey's tank the percentage of run-off in 1891, with 19·81 inches of rain-fall was 20·35 per cent, whereas in 1879 with a rain-fall of 42·35 inches the percentage of run-off was only 10·2 per cent.

Mr. DeWinton's opinion that the runs-off from Sankey's tank catchment are in excess of actual facts in other flat catchments is no doubt correct and in estimating the run-off we should always be on the safe side, especially as our water-supply for several bad seasons in succession depends on it, for it is then that our existing sources of supply would probably fail. I consider Mr. De Winton's data of—

6 M. c.ft. per square mile of catchment in a bad year.
10 M. c.ft. do do average.
14 M. c.ft. do do good.

to be about what we can rely upon in the Rachenhalli Valley and 6—12—17 at Hebbal. If we conserve a large portion of our catchment, and prevent cattle grazing on it, the growth of scrub, grass, &c., will materially effect our run-off and we must keep it down. It should also be remembered that the larger our catchment area the less the percentage of run-off into our tank from the same rain-fall will be.

In the Hessarghatta Scheme Colonel McNeil Campbell has assumed as the run-off, 3·5 M. c. ft. per square mile of catchment in a bad year.

12 „ „ an average year.

and this would represent only

9 per cent of 17″ of rain-fall in a bad year.

15 per cent of 35″ „ an average year.

This run-off is available probably at Hessarghatta and Hebbal, but not in the Rachenhalli Valley.

Since Major Johnson's remarks (quoted by Major Grant) in the discussion at the Institute of Civil Engineers in 1874-75, or 19 years ago, were made, we have had much more data available as to run-off into our tanks, especially such as were observed by the late Major Kensington. The general conclusion arrived at is, that excepting in most exceptional years the run-off on such catchments as Rachenhalli, Hebbal, Hessarghatta, &c., would never reach 20 per cent of the "*annual*" rain-fall. We have actual proof that all the tanks in the Yelahanka catchment do not fill more than once in 3 to 5 years! Their total capacity is only 271 M. c. ft. which only represents a run-off of less than 13 M. c. ft. per square mile on the 21 square miles of catchment, or a little less than the 14 M. c. ft. assumed by Mr. DeWinton as to be expected in a good year. Of course there have been some years in which the tank has been known to discharge 2′ or so for a few days, but we cannot take these as a basis of our supply with safety.

Vide Para 32 for details.

Paras 17 & 18.—Call for no remarks.

Para 19. (*a*).—It may or may not approach to the definition given by Mr. Binnie of the Nagpur catchment, we need not go far to get a very similar catchment in Mysore.

(*b*). The numerous plantations now springing up in this catchment will materially diminish the run-off as we already know from experience near Gubbi on the Southern Mahratta Railway, and in parts of Kolar, where large plantations have been grown.

Para 20.—The remark made by Mr. Larminie in regard to the run-off into Hebbal tank, and put in italics in this para, applies as forcibly, it appears to me, to Mr. DeWinton's assumption that $\frac{2}{5}$ths, or 40 per cent, will run-off the Maligal catchment in a year of 23″ of rain-fall, or to Major Grant's assumption that 40 per cent to 45 per cent would run-off from an average and good year's rain-fall at Maligal; because apparently some such run-off was assumed to have occurred from a few heavy bursts of rain.

Para 21.—Percentages of run-off for short periods are no guide in determining the run-off from the annual rain-fall; more than $\frac{1}{2}$ the rain-fall during the year may be light monsoon rain with no run-off at all.

It is certainly a mistake to take 5 such years as a basis of our supply and demand. Unless your reservoir holds a large supply what will we have for use during our 2nd bad year? It is safer to take 2 bad years' running and leave the good years of rain-fall following the bad years out of our calculations.

The runs-off assumed in this para by Major Grant are:—

6	M. c.ft. per square mile of catchment in a bad year.	
12	,, ,,	average year.
20	,, ,,	good year.

This run-off in a good year is too high and it would be safer to take our known data of 17 M. c.ft. in a good year from the Sankey's tank catchment of only 2 square miles as being the maximum to be expected in a good year from the 14 square miles of the Hebbal catchment.

Very much depends on the character of the rain-fall. Mr. Larminie (in paras 18 and 19 of his report) says "the percentage of run-off received by Sankey's "tank 1st to 5th November 1888 was 13 per cent, although the rain-fall was "three times what was gauged in a previous period when there was 17 per cent "run-off".

Moreover, Mr. Larminie is of opinion (para 35), and so am I, that the runs-off from Sankey's tank and the Hebbal tank catchments are much similar after sudden and heavy rain.

Because we get 30 per cent to 40 per cent run-off from a *sudden down-pour*, it by no means follows that we shall get more than 10 per cent to 14 per cent run-off from the *annual* rain-fall. The rain-fall at Mysore in 1891 was 25·12″ and in 1892 34·33″ and the run-off into the Kukarhalli tank was almost nothing to speak of, as the character of the rain-fall was generally light.

Para 22.—Certainly.

Para 23.—The Hebbal Catchment of 14 square miles is undoubtedly insufficient, and the addition of Sankey's tank catchment would not appreciably help the supply in 2 successive bad years. The Railway now passing at the head of the Hebbal tank is also a factor to be taken into consideration when we come to enlarging the reservoir to 750 M. c.ft. capacity.

Para 24.—We have already had experience of such channels at the Kukarhalli reservoirs at Mysore situated on steeper catchments, and there is no doubt that they cannot be depended upon for a supply in years of light, though not otherwise bad, rain-fall.

Para 25.—Requires no remark.

750 M. c.ft. have to be stored in the Hebbal tank to tide us over 2 bad years and then still have sufficient to carry us on for some 6 months more.

Suppose the contents of Reservoir on the 1st January to be 750 M. c.ft

Drawn off in 1st year			117
Evaporation based on the Hessarghatta data say			246
Percolation do do			75
			438
		Balance.....	312
Add receipts during the year 84+30			114
Total left in Reservoir at commencement of the 2nd year ...			426
Drawn off in 2nd year	117		
Evaporation and percolation based on Hessarghatta figures	257		374
		Balance.....	52
Add receipts during the year			114
		Total.....	166

or only a little more than what would be required for a 6 months' supply!

How can we fill our tank of 750 M. c.ft. capacity when we can only depend on 217 M. c.ft. in an average year from 22·2 square miles of catchment as shown above?

Going on adding catchments in the direction of Nandydroog, as proposed, is such an absurd proposition that it is hardly worth any comment. It would mean several more impounding reservoirs, still greater loss from evaporation and leakage, as we cannot run out the extra water impounded in the same time without enlarging our channels and tunnels; the further we go the less we get for each square mile added, and the cost of any such scheme in proportion to the advantage gained is so great as to at once condemn it.

In a very good year the surplus would be all lost on these outlying catchments over the waste weirs unless we enlarged our outlying reservoirs to impound the rain-fall in exceptional years, this cannot be done at Shinganayakanhalli tank excepting at a large outlay as the Railway would be swamped, for when laying out the line I only made the formation level 6′ above the crest of the waste weir of the tank; moreover, the cost of enlarging reservoirs to impound the run-off in extraordinary good years is generally disproportionate to the advantage gained.

Mr. Scaldwell has, however, given his calculations for the supply in good years, and I merely send his report on, although I do not think we have any right to assume that the year preceding our 2 bad years would give more than the average rain-fall, if we are to be free from all anxiety as to the supply.

Para 27.—The cost of a scheme at Hebbal to give the required supply of 750 M. c.ft. to tide us over 2 bad years would be nearer 200 lakhs than 36.

We can only obtain $\frac{40}{5\cdot2}$ = nearly 7·7 M. c.ft. per square mile (as explained in the previous para), from the Shinganayakanhalli tank catchment in an average year, and if we take as a most favorable estimate 5 M. c.ft. of supply for each square mile added from further outlying catchments towards Nandydroog, we find we shall require about 107 square miles of extra outlying catchment as under:—

Capacity of tank	750 M. c.ft.
Received from 23 square miles as explained before... ...	217
Still required to fill our tank in an average year	533 M. c.ft.

this amount divided by 5 M. c.ft. per square mile = 106·6 square miles.

What the compensation would amount to for buying up all the available supply of water in an average year from 130 square miles of country it is not worth one's while to estimate.

The project *might be cheapened* if we impound all the available run-off in a very good year, but these are few and far between as a rule; we should also lose more in proportion by evaporation in our outlying impounding reservoirs owing to the longer time required to empty them, unless we increased the size of our channels and tunnels, &c., at a large outlay.

Mr. Scaldwell has, however, reported on this alternative in his report.

As in an average year we only get a sufficient supply from the catchment of 23 square miles (217 M. c.ft.) for a year's consumption, what are we to do when a bad year follows?

Sufficient I think has already been said to condemn the Hebbal Project.

Para 28.—Requires no remark.

Para 29.—Hebbal has already been condemned in favor of Rachenhalli by almost all the Officers who have been deputed to examine into the relative merits of the several schemes for a water supply to the Civil and Military Station. Major Grant is, I believe, the only Officer who has propounded the practicability of bringing in the run-off from outlying catchments to supplement the supply. We have had in Mysore large experience in such works; they are scattered in hundreds, perhaps thousands, all over the Province; many of them are out of action, and have been condemned by us after due consideration as not being worth the cost of restoration (these were originally made probably with forced labor which cost nothing), and hundreds of others are now in action.

Feeders to tanks are, as a rule, only paying when we wish to bring water from a river or stream while in flood, or from a stream receiving the tail water from a large area of wet cultivation, into a tank. To feed one tank with a portion of the surplus from another is very often quite practicable when the valleys in which they are situated nearly adjoin, and other considerations, such as nature of country, &c., admit of this being done at a reasonable outlay; but feeding one tank from another in a different valley which does not require the surplus, is a very different thing to conveying the "whole available run-off" from one catchment to another 9 miles away in a channel through such a country as that from the Shinganayakanhalli tank to Hebbal with its 3 miles of tunnelling.

As already shown, we only get $\frac{7 \cdot 7}{12}$ths of the run-off from the Shinganayakanhalli tank catchment actually delivered into Hebbal, although it is only 9 miles away, and the further these outlying catchments are situated the less we get, unless we go to the expense of doubling the size of our channel and 3 miles of tunnelling so as to drain the impounding reservoirs quicker.

PART III.

The Rachenhalli Scheme.

Para 31. *Vide* remarks against para 21. We must take 2 bad years as our basis of calculation for the required supply, and our Reservoir must hold sufficient to carry us through 2 bad years, if we are to be free in the future from all anxiety.

Para 32. Calculations previously given for the Hebbal catchment apply here also, and the Rachenhalli tank must be increased in capacity to impound 750 M. c. ft. to give us a supply of 10 gallons a head for 200,000 people per day during 2 consecutive bad years!

Mr. Larminie says (para 37) "nothing has been advanced to throw doubt on "the Mysore Data, *the great necessity for storing a sufficient supply to tide over* "*one or more bad years can scarcely be questioned.*" We have to fill the reservoirs before our 2 bad years begin. It would also be fair to assume that the two years preceding our 2 bad years would not be more than average years, with a run-off of 10. M. c.ft. (*Vide* para 16) per square mile.

To fill our tank in *one average year*, we must have $\frac{750}{10} = 75$ square miles of catchment. See further remarks paras 33, 34, 36 & 40.

We may have a good year preceding our 2 bad years, and our run-off would then be perhaps 14 M. c.ft. per square mile, but it would not be advisable to depend on such a contingency, and there is nothing to prove that we shall never have 3 bad years running although the probabilities are against it.

The 50 square miles of Rachenhalli and Hebbal catchments together would not suffice to fill our reservoir in a good year, as although the run-off might be $14 \times 50 = 700$ M. c.ft., the water impounded in Hebbal could not be conveyed to Rachenhalli (excepting in a very large and expensive channel) before there had been considerable loss by evaporation, &c., in the Hebbal tank and in the channel itself. No one in his senses would contend that it would be advisable to depopulate these valleys, at an enormous outlay too, as we should do if we deprive them of all the *available supply of water in the valleys even in good years*, except what they can get from wells.

Note.—Further remarks on the Rachenhalli and Hebbal valleys and the run-off from them are given under Paras 33, 34, 36 and 40 &c.

At Hessarghatta the circumstances are entirely different, we can fill our tanks of 888 M. c. ft. capacity with the surplus from the tanks above from one average year's rain-fall.

Again, as further proof of the run-off in the Rachenhalli valley, it is absolutely known that the Yelahanka tank only fills (and sometimes discharges a little) in years of rain-fall above the average, that is, once in 5 years or so. We have got the capacities of all the tanks in this series from the records of the late Irrigation Department who surveyed them,

	Serial No.	C. ft. Capacity.
Sugatta	28	143,748
Nelkunte	29	3,253,932
Gantiganhalli	32	13,329,360
Tarhunse	30	3,659,040
Timsandra	33	18,465,267
Adiganhalli	34	1,743,271
Honnenhalli	35	470,448
Singanayakanhalli	36	73,834,200
Avalhalli	37	1,045,440
Do	38	891,237
Harohalli	39	5,462,424
Devanpalya Nanjundankere...	40	339,768
Ramgondanhalli	41	5,386,629
Virasagar	42	4,589,481
Attur	43	9,801,000
Puttanhalli	44	5,749,920
Yelahanka	45	127,857,312
	Total.....	271,022,479 c.ft.

Two hundred and seventy-one M. c.ft. represents a run-off of 13 M.c.ft. per square mile on the 21 square miles of catchment, and as the Yelahanka tank in good years, does discharge a small quantity, it is evident that Mr. DeWinton's data of 14 M. c.ft. run-off in a good year on the Rachenhalli catchment is about correct. Mr. DeWinton in his comparative statement of Rachenhalli *versus* Maligal assumes 20 per cent run-off from the Rachenhalli free catchment in a good year, and says nothing can be added for the other 29·67 square miles of catchment as he believes that no run-off can be counted on in an ordinary year.

Note.—This is too much to expect excepting in very exceptional years.

It is evident then, that we cannot fill our Rachenhalli tank of 750 M. c. ft. capacity from its own catchment, and Hebbal must be indented on for all its supply as well.

What is to become of our Railway receipts after we have depopulated the country from Bangalore to Rajankunte.

Growing plantations or conserving our catchments, means reducing the run-off.

We know from experience at the Sankey's tank that the growth of grass had a very great effect in reducing the run-off, and last year we had the grass, &c., on the whole catchment cut down. No one moreover would dream of conserving a *large catchment area* by depopulating the whole country, it would be too expensive anywhere in the neighbourhood of Bangalore.

Paras 33 and 34. It has already been proved that, with the run-off to be expected in a good year and to impound a sufficient supply to carry us through 2 bad years, we have to acquire the whole of the Rachenhalli and Hebbal catchments of 50 square miles to fill our reservoirs and leave no water for the resident population and their cattle except what they may be able to get from wells, and that if there is not a good year of rain-fall, but only a succession of average years preceded by and followed by two bad years, it can easily be proved that we should require at least 5 or 6 average years preceding our 2 bad years to fill the reservoir.

What we should have to pay for buying the whole water-supply and depopulating 50 square miles of country close to Bangalore need not be considered ; it would be an enormous sum.

*Mr. Scaldwell has roughly estimated the cost of buying up the land alone with the tanks and including loss of Revenue of 36 square miles at Rs. 24,50,000, but to this has to be added compensation for removal of villages, loss of Railway Receipts, and compensation for Riparian rights below Rachenhalli and Hebbal.

Para 35. Already dealt with sufficiently.

Para 36. These arguments have already been sufficiently noticed.

As will be shown further on, the Hessarghatta is the only scheme which can give us a certain supply for a joint scheme at a reasonable cost, and it is capable of almost indefinite extension. At Rachenhalli whatever extent of catchment may be estimated by different officers as being required, we must pay for the whole available water-supply on it, whereas at Hessarghatta we need only buy up whatever area is considered necessary to preserve the purity of our supply.

PART IV.

The Hessarghatta Project.

Paras 37, 38, 39. Preamble.

Para 40. The conclusion come to by Major Grant that 15 to 20 square miles + Sankey's Reservoir will give an unfailing supply has already been proved to be entirely erroneous if we are to accept the opinions of officers who have studied the question of the run-off to be expected from the annual rain-fall in Mysore for the past 20 years, and if it is also agreed that 2 bad years in succession should be provided against. The only way to prove 20 square miles of catchment sufficient to carry us with certainty through 2 bad years (for to do this we must have a reservoir to impound 750 M. c. ft. at least) would be to arbitrarily assume a run-off from the catchment in excess of actual known data.

The table of rain-fall is unreliable as already stated by Colonel Campbell.

Hessarghatta is not unfavorably situated as regards run-off and rain-fall as compared with Rachenhalli and Hebbal. Colonel Campbell has allowed 12 M. cft run-off in *an average year* ; this is more than we can expect from the Rachenhall

(*d.*) The diameter of the distribution pipes would be the same for whatever scheme we adopt for 200,000 people at 10 gallons a head. As the details have not been worked out I need not now consider this.

III. Whatever Hessarghatta may cost, and the Mysore estimates are quite sufficiently accurate (except perhaps in the items of distribution and annual working charges both of which will require more careful estimating), it is perfectly certain that Rachenhalli will cost more, and that Maligal will not give the required supply. The points in which the differences will occur will be in—

(1.) Cost of impounding Reservoirs with sluices, &c.

(2.) Cost of Rising Main (In the Hessarghatta the cost of duct must be added).

(3.) Horsepower and therefore cost of pumps.

(4.) In the case of Hessarghatta stand-pipe and delivery main (18″ diameter).

(5.) Compensation.

A Comparative statement of these 5 items based on Mysore data are appended. They prove that the Hessarghatta is the cheapest scheme.

It is also the only one which can give us our required supply with certainty for 2 bad years running at a reasonable outlay.

Para 42.—Already discussed.

Para 43.—Dealt with by Col. Campbell.

Para 44.—Merely shows that Major Vibart was right and Colonel Mead wrong. If the project had been then examined in detail we should possibly have had a joint water supply for Bangalore years ago.

Mr. Larminie in his report on the Maligal scheme says regarding Hessaragatta (page 12 c) "There can be no question that a very "large volume of water could be impounded in an ordinary year, as per figures "given in this office No. 74, dated 26th November 1888. Notwithstanding the "greater distance, 11 miles from Service Reservoir site, the level &c.,—&c., there "would be the risk and chances of leakage attending the construction of a high dam "(at Maligal). *At Hessarghatta, the existing tank of a Capacity of* 91 *M. c.ft. with "its massive bund would be, as it were a reliable foundation to start from.*" Major Grant's other arguments in this para of course, all fall to the ground, if the views already expressed in this report are accepted.

PART V.

The Maligal Scheme.

Para 45.—The catchment itself is the best in the vicinity of Bangalore for a pure supply, but its area is only 10 square miles. The run-off is better no doubt than on the other catchments we have considered; this is all granted. The real question is "what supply can we expect to get from these 10 square miles, in a "bad year, in an average year, and in a good year."

The rain-fall on the 21st ultimo (February) was so heavy at the fort that 2 ft. of water was received by the Agrahar tank near Binny's Cotton Mills, or more than was received by that tank during the heaviest rain-fall in the whole of 1892.

The rain-fall was only 0·15 cents at the Alsur Rock on the 21st February last, upon which Major Grant assumes he is justified in dilating upon the *traces of a run-off* from the surrounding hills in the Maligal catchment. On the same day on the 2 square miles of Sankey's catchment the rain-fall was 1·12 inches in one gauge, *0·14 in another and 0·81 in the gauge nearest to Subedar's Chattram. There is nothing to prove that there was *not* 1″ of rain-

*Munireddipaliyam.

fall on the *portions* of the catchment visited by Major Grant. If we get such a difference as 1″ in the rain-fall gauged on a small catchment like Sankey's tank, how can he assume that, because we gauge 2″ in one part of a catchment where we happen to have a gauge, therefore the fall on the whole 10 square miles (say of Maligal) received 2.″? These local tank filling showers are very partial.

The steep slopes on this catchment though good for run-off after heavy rain, are very unfavorable for reservoir sites. Major Grant finds it necessary to provide 4 impounding Reservoirs, and the upper one will silt up in a very few years. The heights of the bunds of these reservoirs as compared with their areas of waterspread are dangerously great, these are noticed further on.

Para 46. The Nagpur catchment is described by Mr. Binnie as "a rocky uncultivable, almost treeless, and uninhabited, tract * *; the grass was partly burned off, partly cut for thatching, partly grazed off". The rock is but so slightly covered with soil that not more than 2½ feet of silt had accumulated anywhere in the bed of the old tank in the 90 years since its construction. Can any one compare this catchment with Maligal excepting in a few selected localities? To quote Mr. Binnie again "as regards "the percentage of the total annual rain-fall which flows "from the ground, almost every drainage area has in "this respect, peculiarities proper to itself." So will we probably get an entirely different character of rain-fall in two localities 600 miles apart, as are Bangalore and Nagpur, and such is the case. How can we compare Nagpur where 93 per cent of the annual rain-fall falls in the South West monsoon in the 4 months June to September with Bangalore? Mr. Binnie further says "no dependence (page 14) can be placed on 3·21 inches of rain-fall in an average year (which falls in the other 8 months of the year), for careful observations have failed to detect any part as flowing from the ground into the reservoir". As every one knows, who has had any experience of Mysore, it is the rain-fall in the months of June, July and August, and early part of September from which we get the least *percentage* of run-off in the Eastern and Northern, and Central parts of the Province, the rain during the South West monsoon being comparatively light, but more general. It is on the heavy * sudden bursts of rain-fall generally experienced *just before* and *just after* our monsoons on which we depend here for our tank filling rain, and moreover these must give us a smaller *percentage* of run-off on the 10 square miles of catchment than at Nagpur because they are partial, and we seldom get these heavy bursts on more than very few square miles of a catchment at the same time. As an example 40 per cent of a 2″ fall on an area of 2 square miles of the Maligal catchment would only give us 8 per cent run-off from the whole 10 square miles of catchment area!

Note.—The effective rain-fall at Nagpur is 93 per cent of the annual fall. We know from Sankey's tank data that the effective rainfall is usually 70 to 80 per cent of the annual fall, and in 1880 was only 57 per cent of the annual fall, and in 1879, 63 per cent.

The *effective* rain-fall from 1st June to 1st October is on an average about 50 per cent of the annual rain-fall, and for the heavy localized showers during the rest of the year, the percentage is higher of course.

Vide Mr. Larminie's Report also on this point.

We have only to glance at the Nagpur Tables of rain-fall and run-off to see that they experience there a very different character of rain-fall than we do here. There it is apparently heavy monsoon rain and can be therefore depended on to be general over the 6·6 square miles of catchment. The rain is continuous and does not give the ground, or crust, time to dry, although apparently there is very little soil at all on the Nagpur catchment to get dry. Take the year 1869-70, at the commencement of the rains at Nagpur in June and July, before the thin layer of overlying soil had got saturated, only 10 per cent of a rain-fall of 12·74″ was gauged (page 15); even taking June, July and August together, with such continuous rain as we probably very seldom get in Bangalore, only 20 per cent run-off was obtained from 22 35″ rain-fall, and this an admittedly one of the best catchments for run-off to be obtained almost anywhere namely, practically sheet rock with a thin coat of soil. The large average percentage of run-off from the annual rain-fall at Nagpur is due to the most extraordinary high percentages of run-off obtained from the rain-fall in September; as much as 98 per cent. of the rain-fall is given in table on page 25 of Mr. Binnie's paper as having run-off in 1892 in one shower! We never can expect any thing like this at Maligal.

It is my firm conviction that it would be quite unsafe to assume a higher percentage of run-off from the Maligal catchment than allowed by Major Grant in his previous report in average and good years.

Mr. Binnie again says *"not only should the account of annual rain-fall be considered, but the fluctuation to which it is liable."*

I object to comparison with Nagpur altogether, but even allowing any comparison can be made, let us examine the data. At Nagpur the run-off quoted by Major Grant was only 15 per cent of 19·38″ of rain fall, the catchment there being better for run-off than Maligal (although the latter is 25 per cent steeper according to Major Grant) and the character of the rain-fall being also better, it would be unsafe to assume more than 15 per cent run-off at Maligal in a bad year of 17″ rain-fall, We might get no run-off at all as in 1876. A run-off of 40 per cent of the annual rain-fall would never be gauged at Maligal excepting in a year of most exceptional and continuous monsoon rain-fall. To take Nagpur data as our guide would, however, be simply absurd when we have the experience gained in Mysore during the last 20 years at our disposal. We have Colonel Bowen's, and the late Major Kensington's, opinions as to the run-off in good, average, and bad years: We have not got data worked out in detail as was done at Nagpur, because we have not got a reservoir (excepting Sankey's) conveniently situated to experiment on.

Mr. Larminie (para 14) says when reviewing the Maligal Scheme, which he was probably just as much struck with as a typical water-supply catchment as any one else would be who had seen it; " 7 M.c.ft. per square mile=3·01 inches of rain-fall, and taking 17″ as the lowest fall, this=18per cent of annual fall, while there is *abundant evidence to show that to obtain so high a percentage the fall must be in sharp heavy showers.*"

We have the experience of the annual discharges from thousands of tanks in Mysore with from 1 square mile to 600 square miles catchment area, situated in almost every conceivable description of country from steep catchments of almost sheet rock to large open level black cotton soil plains; we have rain-fall in different parts of the country varying from 350″ on the western ghats to some 15″ to 20″ in Chitaldroog, and even if actual records of run-off have not been kept, we have more reliable observations to go upon them to indent on Nagpur with its perfectly different conditions of soil and character of rain-fall. We know when the tanks fill, we keep rain-fall returns in every Taluk, we know when the tanks discharge, and in many cases know the periods of discharge; and we know that in a year like 1876 even those tanks situated on typical catchments received little or no water. The extract given by Major Grant from Mr. DeWinton's comparative statement is of no practical use. Mr. DeWinton's statements quoted in this para can only be classed as assumptions from wrong premises. There is no proof that the rain-fall on the catchment on 26th August was not over 5″ on the average, although no doubt there was on that day a very exceptional fall of rain for that time of the year. Why 6 hours has been assumed as the period of rain-fall is not stated. If he had gauged the actual discharge, it might have been of some use perhaps; but even then we should not have got any more data than we have already for percentages of run-off from the *annual rain-fall.*

Paras 47 and 48.—Because the Maligal Catchment is 25 per cent steeper than the Nagpur, it does not follow that the run-off will be 25 per cent more in a bad year. As Colonel Bowen remarked in a letter to Sir Oliver St. John" in such a famine "year (as 1876) the probabilities are that there would be no run-off at all in the "Maligal Catchment ". In fact there was little or no run-off to speak of in 1876-77. I was on the Mysore State Railway under Mr. W. Henderson in 1876, and was personally in charge of the Railway bridge over this stream as well as other works on the Railway, and I visited the Maligal valley probably every day while employed on Famine work, surveys and construction, as far as Kengeri; I can say from personal observation that there was not one single flush down this stream of over 6″ in depth from August 1876 to October 1877 or even later, and that the bed was perfectly dry, and no water nearer than 3′ to 4′ of the surface for at least 9 months.

Major Grant's assumed percentages of run-off in his first report are even greater than what we can rely upon, and I would be inclined to adopt 15 per cent in a dry year, 20 per cent in an average year, and 30 per cent in a good year, as an outside estimate for this catchment, which would give,

in a bad year of	16·5″ rain-fall	10 × 6=	60 M. c.ft.
in an average year	30·65″	,, 10 × 14=	140 M. c.ft.
in a good year	45·60″	,, 10 × 31=	310 M. c.ft.

Para 49.—Captain Ward's estimate of evaporation is much under the mark as proved by actual experience of tanks in Mysore. At Nagpur it was $\frac{1}{8}$ inch a day in a reservoir containing 2 years supply of 240,000,000 c. ft.

Colonel Le Messurier, R. E., who was several years in Mysore, says 6′ a year.

It is necessary, as we *cannot prove otherwise*, to assume $\frac{1}{5}$ inch a day at Maligal.

Para 50.—Percolation through high bunds, or below them as would probably be the case at Maligal, is always greater in deep tanks.

The geological formation of the Maligal valley is igneous, in a few places trap dykes are upheaved vertically and on one of these Major Grant proposes to build his masonry dam; there are also numerous quartz reefs, and the strata generally is much disturbed and full of fissures; it would not be advisable to allow less than $\frac{1}{7}$″ capacity of the reservoir for percolation. It is no use taking the most favorable view of the case with such unreliable foundations as we are sure to get in this valley, more especially as it is proposed to build the masonry dam on a trap dyke. The site for the masonry dam I have personally visited as well as the sites for the earthen dams.

Para 51.—Requires no remark.

Para 52.—The consumption is taken as being 117 M.c.ft. a year. Let us assume the runs-off given in para 42 and see what will happen in 2 bad years following a good year.

1 Good year's rain-fall would not fill our tanks, only 3 of them will fill.

We get in a good year			310 M. c.ft.
Figures given in Major Grant's first report are taken here.	Consumption in the good year	117·0.	
	* Evaporation $\frac{1}{5}$″ a day $3 \times 26{\cdot}5$	=79·5.	
	* Percolation $\frac{1}{7}$″ capacity $3 \times 14{\cdot}3$	=43·0.	
			239·5.
Balance remaining for a bad year			70·5.
Received during a bad year			60
Left to carry us through 1st year			130·5.

or about $\frac{1}{2}$ of what is required to carry us through one bad year.

Sankey's tank can be left out of consideration; it would give us little or nothing in a bad year.

Para 53.—The table is of no use, the rainfall on Sankey's catchment is nearer to the head of the Maligal catchment.

Para 54.—The difficulty *is* the sufficiency of supply and *not* the cost of storing it. The cost of storing the small supply available in the Maligal valley is no doubt very great indeed—about 7 lakhs, but not so at Hesseraghatta, where we can store 380 M. cft., at a cost of 2 lakhs, or at the very outside $2\frac{1}{2}$ lakhs; and if we chose to reduce the size of our reservoir, and store only 750 M cft., the estimate would be reduced.

82. If Major Grant's earthen dams breached, which is very probable in a cyclonic fall of rain on this steep catchment with the small areas of water-spread of his reservoirs, what are we to do for our supply? At Hessargatta we have only got to indent for a limited period on some tank, or tanks, in the series for our supply by paying compensation for the year's crops.

Para 55.—This should certainly be considered, as the extension of the catchment is required without any doubt whatever, *vide* para 52.

Paras 56 *and* 57.—These artificial extensions of catchment are—

(1.) Tanniranhalli (Mattikere) tank 3 square miles at a cost of Rs. 43,000.

(2.) Another 3 square miles of catchment to be brought into the Mattikere tank at a cost of Rs. 15,000, or 6 square miles at a cost of Rs. 58,000 for works.

It is not known why compensation, &c., has been omitted by Major Grant.

(1) and (2). These 2 proposals must be taken together as the Mattikere tank must be enlarged to impound the run-off from these 6 sq. miles of catchment, the small channel with 5′ wide being of course quite useless excepting to draw off water from an impounding reservoir.

Take the run-off assumed by me for Hebbal in an average year, (or 12 M. c. ft. per sq. mile) as the quantity to be impounded, this would be $12 \times 6 = 72$ M. c. ft.

The capacity of the tank at present is 15 M. c. ft. and we will have to raise the weirs 9 feet. We shall have to place the tank beyond all reasonable chance of breaching, and the cost of doing this including the cost of necessary extensions of waste weirs is estimated by Mr. Scaldwell at Rs. 25,500. This estimate provides for the top of bund 8′ above weir level and 8′ wide at top.

We shall have to divert two railways, or raise their formation level 9 feet at least, and as the Railway Authorities will object to carry out any alternative but a diversion to west and to outside the water-spread for the Poona line unless we pay for revetting or pitching their bank, 2,000 c. yards of pitching would be required or Rs. 2,000. Whether they would insist on a diversion outside the water-spread need not be considered, as if they did the whole of the junction station at Yeswantpur would have to be rebuilt elsewhere, and the diversions would cost probably lakhs of rupees.

We have now to consider the proposed feeder-channel to bring in 3 sq. miles of catchment. As stated before under para. 26, it is the short heavy bursts of rain which we have to deliver, we get a larger percentage of run-off from these which occur a few times only in the year, and as it is on these few showers which the percentage of the annual rain-fall chiefly depend we cannot neglect them; we may get at least $\frac{3}{4}$″ run-off from a burst of 3″ in an hour from a small catchment of 3 sq. miles, and it is usual in our waste-weir calculations to provide for 1″ run-off with 3′ head. If our channel was 2′ bottom width to start with it would have to be enlarged at the end to deliver $\frac{2323,200}{60 \times 60} \times \frac{3}{4}'' = 972'$ c. feet a second. We cannot give it the steep fall proposed by Major Grant, it would soon become a perfect ravine unless it was in rock, in fact it would never do, if we want to preserve the channel in an efficient state, to give it a fall of more than 4 feet a mile to start with tailing off to 2′ a mile or say 0·4 per 1000′ in the big channel at the end; the latter with a fall of 2′ a mile would require a channel of 60 feet bed width running 5 feet deep with a velocity of nearly 3′ a second. We must provide also for relieving weirs to pass abnormal cyclonic falls over, or under, our channel; the former is cheaper probably, and assuming that our relieving weirs are to discharge 2′ over crest, we get roughly 10 cft. a second discharge for each L. ft. of weir, or 36,000 c. ft., an hour. If we assume the abnormal fall to be passed over to be 2″ of rain-fall per hour in each square mile of steep catchment, we will require $\frac{2 \times 2,323,200 \times 3}{36,000} =$ 387 R. ft. of weir. The cost of such a feeder channel—assuming that no very hard rock will be met with in excavating it (which is doubtful), and taking into consideration the compensation to be paid for depriving tanks below it of water, and also the two tanks above it—is given further on. If it is intended to preserve the purity of the water, which Major Grant (I admit perfectly unnecessarily) is so anxious to do, we will have to pay compensation for the whole 6 miles of this catchment and remove all the villages.

We have next the channel with the masonry duct inside it. Major Grant's estimate may be accepted for this item, but the Railway Authorities may not allow us to lower the floor of their culvert by 5 ft., which would be required to drain the tank.

The total cost therefore of bringing these 6 square miles of extra catchment will be nealry 2 lakhs as under :—

Cost of contour channel	40,000
Relieving weirs	4,000
Compensation for tanks and land for channel	54,000
Channel and masonry duct, Major Grant's Estimate	43,000
Enlarging Mattikere tank	25,500
Total Rs.... ..	1,66,500

and to this must be added the cost of what the Railway may consider necessary to cover necessary work for raising their bank, &c., &c. say Rs. 30,000.

So that if we only buy up the tanks and the areas irrigated, and the land for the channel, the cost will be about Rs. 2,00,000.

Major Grant's estimates of Rs. 43,000 + Rs. 15,000 = Rs. 58,000 are of course entirely wrong. Next we have to consider what supply we can expect to get *actually delivered into our terminal reservoir from these 6 sq. miles of catchment.*

If all the reservoirs are full, we cannot run-off the water we have stored in the Mattikere tank until there is room for it in the 1st reservoir situated 2 miles away in the Maligal valley, and in the meantime evaporation and leakage is going on in the Mattikere tank which has a very large water-spread of 193 acres for a capacity of 72 M c.ft.

This would be the case only in exceptional years of over 45" annual rain-fall.

We can assume the consumption, evaporation, and leakage, in the 4 reservoirs in the Maligal valley to be *$\frac{280}{365}$ M c.ft.=767,000 cft. a day, and as our Masonry channel cannot carry more than 500,000 cubic feet a day, we shall want 100 days to empty the Mattikere tank as shown below :—

*280 M.c.ft: is assumed as yearly required for consumption, evaporation, and leakage.

In an average year we can assume that there is room for the water to be run down at once; but all sorts of complications are encountered in estimating the supply we shall really get. Let us take a simple case, what shall we lose by evaporation and leakage in the tank and in 2 miles of Channel in the time required to let down the water into the first reservoir in the Maligal Valley ?

The masonry duct will discharge (*vide* para 26) 6 c.ft. a second or 500,000 c.ft. a day :

In 100 days we shall run out..	60 M. c.ft.
The loss by evaporation at $\frac{1}{5}$th a day on an average of 120 acres in 100 days, and by percolation at $\frac{1}{4}$th the average capacity in the same time	12 „
Total...72	„

We shall certainly lose 5 per cent in 2 miles of duct balance 60—3=57 M.c.ft. delivered into 1st reservoir. In an average year the 1st and 2nd reservoirs may be assumed to be empty (but they will be constantly receiving the run-off from their own free catchments which must be let down to 3rd and 4th reservoirs *vide* run-off given in para 48) the water is then let down into the 2nd and spreads over the bed. The 3rd reservoir after 100 days will probably be half emptied, and it is let down into this.

The size of the sluices is not given, but we may assume that it is intended to let down into the terminal tank only what is consumed in a day, for to keep the terminal tank *full always* would be suicidal, as we would lose all rain-fall over the 0·70 sq. miles of its independent and free catchment over its weirs. The complications involved in such a system of 4 reservoirs are so great that it is quite impossible to *prove* anything. We may quite safely assume that he would not get the supply from the Mattikere into the *terminal* reservoir, before losing 50 per cent at least of the 57 M. c.ft. let down into the 1st reservoir, because we *cannot fill but*

must leave room for all the run-off from each of the independent catchments of the 4 reservoirs and we cannot foresee what rain will fall or when. We shall not be able to deliver more than 30 M. c.ft. into the terminal reservoir in an average year. The fact is we shall only get 5 M. c.ft. a square mile in an average year from these 6 sq. miles of added catchment or about $\frac{1}{12}$th of what we impound in the Mattikere tank to start with; and this cannot be called adding 6 square miles of catchment.

Para 58. The soil in many parts of the Maligal valley is porous and the rocks in many places much broken up and disturbed and eruptions of trap and quartz with vertical (or nearly so) strata are common. Water finds its way easily into the fissures and soil, but can in many places only force itself out again slowly in the shape of springs. These springs are common all over the gneisse and schistose formations so prevalent in Mysore. Theorizing without proof is of little value however after all.

The cost and resulting advantage of bringing in the Shinganayakenhalli tank catchment into the Hebbal tank I have already dilated upon (para 26); but to bring the same catchment into the Mattikere will depend upon the levels, and I have not got them to refer to.

Para 59. We now come to Major Grant's proposed addition of the Malathalli catchment.

He has allowed nothing for the following items:—

(1) Increasing the capacity of his impounding reservoirs at Hallal and Malathalli to impound the run-off in average years from 4 sq. Miles of catchment, or say $4 \times 12 = 48$ M. c.ft.

(2) Compensation for bringing up the tanks and also, if it is intended to adopt the "*purity of supply theory*" to buy up the whole area of 4 sq. miles and the villages on it.

(3). Nothing is provided for bringing the run-off from the 1·33 square miles of Hallal catchment into the Malathalli tank. Having got our supply into the Malathalli tank we cannot let down this supply into the terminal reservoir in an average year until the supply from the 3 upper reservoirs and the Mattikere tank have first been let down and utilized, and we have always got to keep our terminal reservoir partly empty. If we assume that of the 200 M. c.ft. of supply from those reservoirs 150 M. c.ft. is consumed, evaporated, and lost in * $\frac{150,000,000}{767,000}$ say 200 days, and no rain is received on those 200 days to supplement the supply, the 48 M. c.ft. in the Malathalli Hallal reservoir will be considerably reduced probably to 30 M. c.ft.; we can then *begin* to run it down at the rate of 500,000 cft. a day in the Masonry duct $2\frac{1}{2}$ miles long; this will take 60 days more, and we may deliver with losses in the tank and channel 20 M. c.ft. into our terminal reservoir.

Note.—It is not worth while estimating for this channel, the cost of bringing in these 4 square miles if value of tanks, compensation, &c, be taken would be nearer $2\frac{1}{2}$ lakhs than 1,70,000 Rs.

* Vide Para 57.

If in a fairly good year the rain-fall is enough to keep his supply in the terminal reservoir at the maximum allowable, the water in this Malathalli tank can never be let down at all; *or in other words we have the choice of letting the supply evaporate and leak either at Malathalli, Mattikere, or any of his other reservoirs.*

Para 60. The contour channels proposed will of course be useless. We must keep the terminal reservoir say $\frac{1}{2}$ full, and if it rained sufficiently hard to bring a supply down his long tortuous channel, the terminal tank of 100 M. c.ft. would soon fill and run over, and this cannot be called bringing in a further catchment of so many square miles. In fact the terminal reservoir is much too small.

From these 10 square miles of added catchment in exceptionally good year we can keep our 4 reservoirs full, and if 2 bad years followed the supply in these bad years from these outlying valleys would certainly not be more than $\frac{1}{2}$ that received from them in an average year.

The supply in an average year will be only 30+20+22 (Sankey's)=72 M. c. ft., so in average year we cannot much more than ½ fill our 4 reservoirs, for we can only get 140+72=212 M. c. ft.

We want for consumption in one year ...	117	
Loss in say 2½ reservoirs by evaporation and leakage ...	95	212
Balance		Nil
If another average year was experienced receipts		212
Total.....		212
Consumption loss and evaporation say		212
Balance.....		Nil

and so on. We may thus possibly get sufficient of these 20 square miles of catchment to *just suffice* for our requirements in an average year, and if one bad year followed we should experience a water famine.

As before explained a good year will only carry us through ½ a bad season, and if our 4 reservoirs were full to the brim on 1st January of the first bad year, a contingency not to be depended upon, we should possibly be able to tide over 1 bad year and ½ of another.

We may accept Major Grant's estimate for the Maligal scheme; I am certain it cannot be done for less than 34 lakhs. To this we have to add the cost of the additional 10 square miles of catchment which at the lowest estimate we can take as being 5 lakhs if the whole area is to be bought up to ensure the purity of supply advocated by Major Grant.

Note.—The cost of his 3 earthen dams and the masonry dam I would estimate approximately as under,

No. 1 Reservoir ...	1,25,000
Nos. 2 and 3 ...	2,75,000
Masonry dam ...	3,00,000
Total Rs.....	7,00,000

For a large outlay of probably 40 lakhs we shall thus have an uncertain supply in average years, and experience a water famine in the 1st year of deficient rain-fall just when we require a supply most.

Para 61.—The fallacy of Major Grant's asssumptions of our being able to get the run-off from even our nearest and most accessible catchments into the Maligal valley at a reasonable outlay has been shown, and there will be no use therefore in wasting time to prove that the catchment cannot be doubled so easily and cheaply as he supposes.

Note.—He can only deliver 5 M. c. ft., per square mile of added catchment per year from an average year's rain-fall.

Paras 62 *to* 79.—These paragraphs only refer to the details of the scheme. It is Major Grant's duty apparently to design his own scheme, and get out his own specifications for the work. If he thinks Hessarghatta specifications (as he calls them) unsound, he need not adopt them, but to arbitrarily assume that they are in many respects capable of application to his Maligal scheme I deny. Each Engineer when deputed to get up a project must use his own judgment as to what he considers best, and with due regard to the safety of such works as reservoirs on which our water-supply is to depend. At Hessarghatta we have already got (1) an old bund in perfect order 50′ wide at top up to within a few feet of the level of our proposed waste weir, (2) a large water-spread of 2¾ square miles to act as a moderator in time floods due to abnormal rain-fall, or to the breaching of a few tanks above, and (3) it is proposed to make our bund 13′ above our waste weir level. Major Grant argues that he can adopt our rates for his 4 new reservoirs which, in my opinion, have very insecure and dangerous foundations, he has provided for no waste weirs at all (as far as I can see), and the top of his earth bunds are to be only 5′ above F. S. L. which in Mysore we consider unsafe even for smaller irrigation tanks.

As regards the remark in para 74 about the distance pipes have to be carried especially at Hessarghatta, it need only be remarked that they can be unloaded out

of Railway trucks actually on the site of our Rising Main after being brought by rail from Goa without any transhipping at all, and for the delivery main we shall ever have less lead for carting than he has at Maligal.

Para 80.—These have already been proved to be entirely erroneous assumptions. But the mere fact of having 4 unsafe reservoirs is enough to condemn the Maligal Scheme for a joint water-supply. The upper of these reservoirs will silt up in a very few years to the top of the bund probably, and the others a good deal every year unless scouring sluices are provided and, as the water in a very exceptional year cannot all be stored, we may be able to use some small quantity to scour out our reservoirs, but in other years the silt will have to be removed by hand when the reservoirs are empty (*vide* para 16, Mr. Larminie's report). To build dams in this valley is feasible, but the cost, if we are to make them reasonably safe from accident, will be a good deal more than estimated by Major Grant, and we have got to add 3 more outlying reservoirs, with some 10 miles of channel.

Note.—To make them perfectly safe would cost too much.

Para 82.—No one can say what the rain-fall was in this valley on those days. It is however known that the Maligal valley is favorably situated for these local showers early in the year, and unfavorably situated for the showers in the N. E. Monsoon. On the Sankey's tank catchment of 2 square miles we have 5 rain gauges carefully kept, and the rain-fall on this small area on these 2 days is here given :—

	15th March. Inches.	17th March. Inches.
No. 1 Gauge Munireddipalyam (N. E corner of area)	0·17	1·18
„ 2 „ North of Mattikere (N. W. do)	0·12	1·33
„ 3 „ near Reservoir	0·16	0·99
„ 5 „ near cross roads W. of reservoir	0·28	0·92
„ 6 „ at the Rifle Range	0·81	2·17

Judging from the direction taken by the storms on these 2 days it is probable that the centre of the heaviest rain-fall was from the direction of the village of Nagarbhavi straight over the Mantapam hill. The Maligal valley received probably an average of $1\frac{1}{2}$" rain-fall over nearly its whole area as the storm must have passed right up it for a distance of 6 miles.

Para 83.—The real divergence of opinion between the Dewan's views and Major Grant's appears to me to be that the Dewan proposes to carry out now, at a cost of 31 lakhs, a scheme which will require little or no additions for the next half century, and with a perfectly certain supply ; while Major Grant advocates a scheme which will give a minimum supply and recommends that we should wait for a water-famine to prove that it is incapable of giving even that. We can then extend the catchment by 10 square miles, and the little advantage obtained by this addition has been shown in this report.

No one, as far as I am aware, intended to do more than bring in a sufficient supply for domestic purposes.

Whether it is best to avoid " the costly dislocation of the main features of the scheme" and provide now for probable future requirements as advocated by the Dewan or not is quite another thing, and must be left for Government to decide. At Hessarghatta both schemes will probably be worked out in detail.

Para 84.—Of course the summary of conclusions is all one-sided.

Paras 85 *and* 86.—Already dealt with.

Para 87.—It has already been explained that there is *considerable difference in buying up all the available water-supply in the Rachenhalli and Hebbal catchments, to buying up only an area considered sufficient to conserve our catchment as at Hessarghatta*, where the surplus from the 170 and odd tanks above is more than sufficient in one year of average rain-fall to fill our tank without buying up any land at all.

Major Grant's run-off at Rachenhalli in a good year is too high. This is known from actual records.

He may get such a run-off at Hebbal, but the catchment is only 14 square miles in area. The Hessarghatta catchment is just as well situated as Rachenhalli as regards run-off. Colonel Campbell purposely took the worst possible view, as such a run-off was experienced on Sankey's catchment and might occur elsewhere on a larger area over which the rain-fall would not be uniform. In 1892 we had 3·64″ of rain on 25th June, and 3·34″ on the 28th June, at Dodballapur (cyclonic) and the tanks surplussed all down the valley; this is one of the advantages of having large catchment areas in this part of Mysore where the monsoons are usually light, and heavy storms generally partial. In 1892 the rain-fall was 27″ on Sankey's catchment and only 9 per cent was received by the tank. We cannot definitely say we will never have a 3rd year of dróught (*i. e.* as regards failure of tank filling rain) we may have 36″ of rain-fall with a little or no tank filling rain at all. The run-off from streets and houses as in the Cantonment and the Petta should be more than on ground covered with grass, bushes, scrub, and plantations. The run-off from Sankey's tank fell off enormously as soon as the catchment was conserved and cattle grazing and cultivation prohibited. We cleared the greater portion of this catchment only last year from grass, &c., and rain-fall has since been unfavorable to its re-growth.

Note.—It may be mentioned here that the high percentage of run-off in years of bad rain-fall actually obtained from Sankey's catchment, and which was taken exception why Mr. De Winton (*vide* para 16 Major Grant's report) was probably due to there being little or no growth of grass in such years.

In Hessarghatta an entirely new departure is not taken, but it was considered, and I presume very reasonably, that it is the cheapest scheme to adopt, for in reality we need not buy up more than 3 tanks at all, as we have got the surplus from the upper tanks to fill our reservoirs in an average year.

As already explained at sufficient length other things are not equal.

Paras 89 *to* 97.—Nearly all re-capitulation of previous remarks.

Para 98.—The delay would be in the Maligal Schemes with its numerous reservoirs to construct and several miles of channels to excavate.

At Hessarghatta there need be no delay, the tank can be started as soon as orders are once given to do so; and as soon as these discussions are over as to the relative merits of the rival schemes, the pipes and machinery can be ordered.

At Hessarghatta there will be no difficulty whatever in acquiring the tanks and any area it may be considered necessary to conserve in the immediate vicinity of the reservoirs "Straight of the reel."

General Mullin's and Mr. Lyall's remarks here quoted do not apply to Hessarghatta, as they do to Rachenhalli or Agaram. There are no tanks below and therefore no Riparian rights.

Para 99.—Major Grant has to my mind drawn an exaggerated picture to illustrate his views. He has not one single argument to adduce in favor of the Hessarghatta Scheme. On the other hand, I can only see one possible argument in favor of Maligal, and that is the supply would be purer if we could get the quantity required at a reasonable cost. There should also be extra gathering grounds available for possible future extensions of our catchment if required, and some supply to fall back upon in case of accident to the Reservoirs.

Work can be started at Hessarghatta as soon as the Dewan sanctions the project which is ready; the designs have already been approved.

Comparative Statement of Approximate cost of the Hessarghatta, Rachenhalli and Maligal Projects.

Note.—Only those Heads of the estimate which are not common to all the Projects are given in this Statement. For other Heads the cost would be the same whichever project were adopted with similar specifications. The Hessarghatta estimate has been reduced to supply 2,000,000 gallons a day to allow of a fair comparison being made :—

No.	Heads of Estimate.	Hessarghatta Project. Cost in Rupees.	Rachenhalli Project. Cost in Rupees.	Maligal Project. Cost in Rupees.	Remarks.
1	Impounding Reservoirs including off-take Sluices	2,50,000	7,00,000	2,50,000	Rs. 50,000 have been added in each project for off-take sluice, &c Hessarghatta Reservoir will impound ... 767 M.c.ft. Rachenhalli ... ... 612 do Maligal—4 Reservoirs ... ... 400 do
2	(1) Rising Main 20″ diameter	1,30,000	3,20,000	3,50,000	A 20″ main will deliver 3,000,000 gallons in a day of 24 hours with 2·674 ft. a second velocity, so it will deliver 2,000,000 gallons with a velocity very little over 2′ a second. Weight of pipes is taken as 200 lbs. per foot. Hessarghatta Main ... ... 8,580′ in length. Rachenhalli ... ... 21,000 (approximate.) Maligal 22,290
	(2) Valves and fittings	5,000	9,000	10,000	
	(3) Masonry duct	1,10,000	...	...	The delivery channel has to discharge only $\frac{3}{5}$th of quantity provided for in Original Project.
3	Pumps and Engines...	1,15,000	58,000	1,28,000	The Horse-power has been re-calculated for pumping 24 hours continuously, =222 c. feet per minute. H. P. required-Hessarghatta $\frac{222 \times 62{\cdot}5 \times 400}{33{,}000} = 168$ or say 170 H. P. Do Rachenhalli $\frac{222 \times 62{\cdot}5 \times 200}{33{,}000} = 84$ or say 85 H. P. Do Maligal $\frac{222 \times 62{\cdot}5 \times 450}{33{,}000} = 189$ or say 190 H. P.
4	(1) Stand-Pipe	10,000	...	...	The cost has been taken @ 340 Rupees per H. P. (*Vide* Para 8, Col. McNeil Campbell's Supplemental Report.)

We should have however to get Engines of at least 50% greater H.P

	(2) Delivery Main	3,60,000	...	...	The Delivery Main has been taken as being 18″ diameter which will deliver 2,585,000 gallons in 24 hours with 2·830 ft. per second velocity. Thomas Piggott, & Co's Rivetted (mild) steel pipes are provided for, 25′ in length with socket joints. 7,000 R.ft., $\frac{1}{4}$″ thick shell @ 10 s. 11 d. per ft. 15,000 R.ft. $\frac{3}{16}$″ 9 2 do 15,000 R.ft. $\frac{1}{8}$″ 7 3 do Prices quoted are F. O. B. Liverpool :— The cost of pipes F. O. B. Liverpool @ Rs. 17 per £ = ... 2,74,270 Freight and Railway charges @ Rs. 30 a ton for 667 tons = ... 20,000 Laying @ Re. 1 per foot (light and 25′ in length). = ... 37,000 For expansion joints, bends, valves, &c. = ... 8,730 3,40,000 Contingencies, say...20,000 Total Rs...3,60,000
5	Compensation	2,20,000	2,50,000	30,00,000	At Hessarghatta compensation has only been allowed for buying up a few tanks, and a small area in the vicinity of their water-spreads to conserve the supply. At Rachenhalli only a very rough calculation can be made, the whole catchment including Hebbal must be bought up and people deprived of all available supply in good years. All tanks being breached.
6	Buying up extra 10 square miles at Maligal with cost of works	....	5,00,000		At Maligal the whole catchment is proposed to be bought up to ensure the purity of supply. Compensation will be however considerably more now, as several plantations have since been grown on the catchment.
7	Reservoirs at Hebbal to impound 282 M. c. ft. and channel	...	...	?	Approximate only, *Vide* body of Report Para 60. Not worth while to estimate as the Railway will be swamped and diversio rendered necessary. The cost of enlarging the tank alone and mak i necessary channel will cost 1 lakh at least.
	Grand Total Rupees...	12,00,000	18,37,000	37,38,000	

BANGALORE,
Dated 10th May 1893.

W. McHUTCHIN,
Offg. Chief Engineer of Mysore.

Mysore Government Central Press, Bangalore.—15-5-93.—100.

Nos: 2611
Pr: 536

To 1st Assistant to Resident in Mysore

In reply to your letter No: 1958 of 25th inst.

I.G.I. Mr. Lewis & Mr. Rice

Sig report of the Cases which have been sent into the Statistical Office by the Surveyed Districts & which the Statistical has submitted to the Press for Publication & Check in this Office.

2 Incorrect Statement is herewith submitted for Information with a request that the Copies sent to the Resident may be corrected accordingly.

I have to explain that the figures ~~have been~~ given by the Police have in a few instances been tampered under Kaliconolli instead of Kaliguda, Hosa Kere, and the Returns should have been Kaliguda in Column 2 & Kachenahalli in Column 3.

Yours &c

MG

Offg: Secy:

15/6/93

10 Copies in all.

Put it up with the Papers to be sent to the Resident for his compliance. 17/6

Geo. MG

(Serial No. 30.)

1893

From The 1st Assistant to the Resident in Mysore

To

Dated 7th June 1893

Despatched

Received

OFFICE OF THE ... 16 JUN. 93 ... MYSORE

SECRETARY'S OFFICE REG'D. NO. 2221 12 JUN. 93 MYSORE

621

SLI

Enclosures No.

General No. 1955

No. 28.58

Asking for a full explanation of the figures contained in the table at the end of Mr. Mc Nicholls printed Note on the Report by Major Graham on the General Scheme for the water supply of Bangalore

No: 2748
G.5110

Transferred to the Secretary. 17/6 B.O.

Mr. Narasimha Rao

15/6/93 Under Secy

No. 958/888

(5)

FROM

THE FIRST ASSISTANT TO THE RESIDENT IN MYSORE.

To

The Dewan of Mysore.

Dated Bangalore, 9th June 189 3.

SIR,

I am directed to invite your attention to the table at the end of Mr.McHutchin's printed "Note on the Report by Major Grant, R.E.on the several schemes for the water supply of Bangalore"dated 10th May 1893 and to ask for a full explanation of the figures contained in that table under the head of "compensation" which are as follows:-

Hessarghatta project------	----------Rs.2,20,000.
Rachenhalli----- Do--- ---	---------- 2,50,000.
Maligal----------Do ------	---------- 30,00,000.

The Resident is unable to understand from the text of the Note the apparently disproportionate amount of compensation shewn against Maligal.

2. In connection with this question I am to ask also that the Resident may be furnished through the Superintendent of the Revenue and Settlement Department with extracts from his Registers showing the amount of land under cultivation and the assessment paid on the same within [1], the actual catchment area of the Maligal project and [2], the increased area which Major Grant proposes to add if necessary.To save trouble and time Major Grant has been requested to furnish Colonel Grant with a sketch map showing these areas and to give him any personal explanation that may be necessary.

I have the honor to be,

Sir,

Your most obedient Servant

[illegible]

First Assistant Resident

1893

MYSORE P. W. DEPARTMENT.

No. 268

From The Chief Engineer of Mysore.

To

Dated Bangalore 19-6-93

Despatched

Enclosure No.

Subject.

ORDINARY

No 81
with Executive Registry
Statistical Statement

(7)

Survey Superintendent's Office
Bangalore 4th August 1893

To,

The Chief Secretary to the
Government of Mysore
Public Dept.

Sir,

I have the honour to acknowledge the receipt of your letter No. 2681/548 of the 19th June 1893 forwarding the enquiries without of Part II of letter No. 1953 dated 28 88 of the 9th idem from the Director of Statistics to the Resident in Mysore & the address of the Dewan of Mysore.

2. I observe that a separate return is required on Article 4 of Part II

Registers

Register showing the amount (viz)
and assessment of the land within
(1) the actual enclosure and of
the illegal project and (2) the
increased area which this
Grant proposes to add, if neces-
-ary. Nothing whatever is said
about compensation and therefore
I will not touch upon that point
it all but will confine my-
-self to furnishing, with as much
accuracy as the scale and
nature of the Map supplied
to me will permit, the area
and assessment of the land
included

1893 94

MYSORE P. W. DEPARTMENT.

No. 3469 / 690

From

The Secretary to the Government of Mysore,

To

The Asst to Resident in Mysore,

Dated Bangalore, 7—8—93

Despatched

Enclosure No. / Subject. Statements Submitting Survey Letter dt: 8/94-8-93

9

Sir,

I have the honor to forward the enclosed copy of letter No 37 dated 4th inst, from the Supdt, Mysore Revenue Survey, with the 8 statements therein referred, furnishing the information called for in para 2 of your letter No 1353/28-PA dated 9 June 93, as regards the remuneration and assessment of the establishment of the Survey project, and the amounts are proposed to be added by Imperial Grant.

I have &c

for Secy

THE RESIDENCY MYSORE

Bangalore
7th August 1903

Sir,

I am directed to refer you to the correspondence ending with the letter from the Secretary to Govt. of Mysore in Public Works Department No. 3402/690 B. R., dated 20th August 1903, forwarding certain Sketches showing the area of land required for the extension of the Kaveri water supply Scheme, and the assessment leviable from that area.

As you are aware the Govt.

of India to determine & adjust the Boundary lines & the separate titles existing of the C. & N. Railway and the Indian Government in such lines as to give to the Railway Company the required acquisition of the Railway Settlement area and to enable the Government to make such payment on this account as may be made within the current financial year as funds may be available.

Colonel Swanton understands that there will be no difficulty as regards the acquisition of the Settlement area, and the only question is

(44)

GOVERNMENT OF MYSORE

12

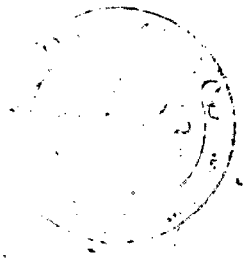
Do.

Nov 8.

My dear Col Campbell

I send you herewith
what passed between me &
Resident in regard to Bangalore
Water Supply. I wish to have
the Sankey file for reference & know
if you have at all worked
at the Mysore Cum Sankey?

Can you readily find out
how many tons of 12 inch pipes
will be required for the



13

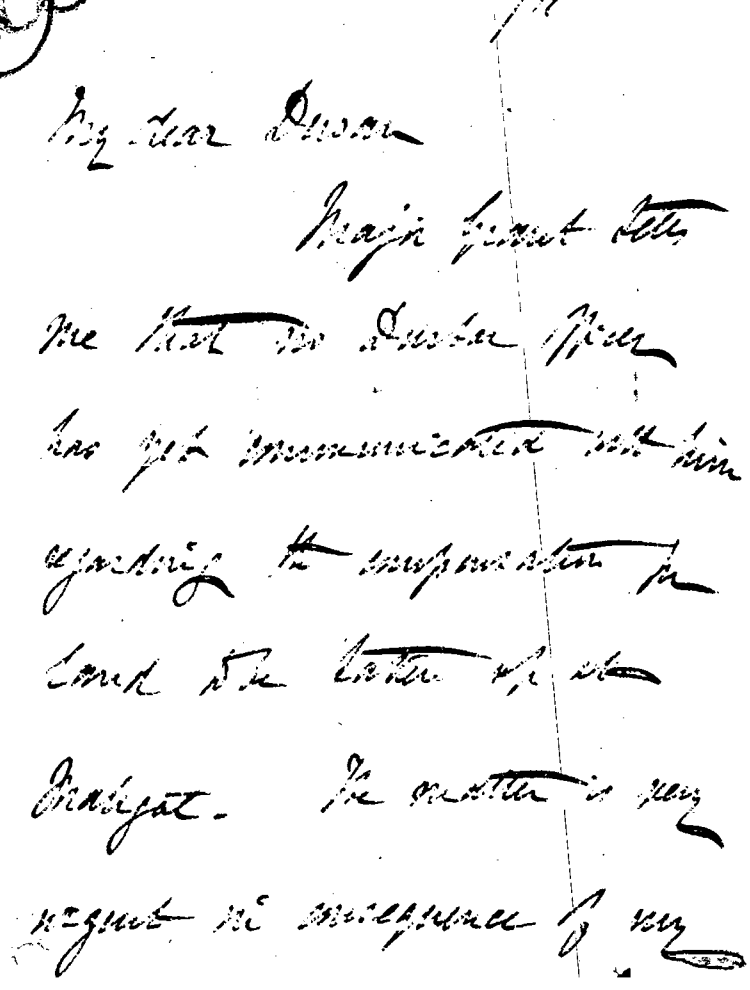
15/11/93

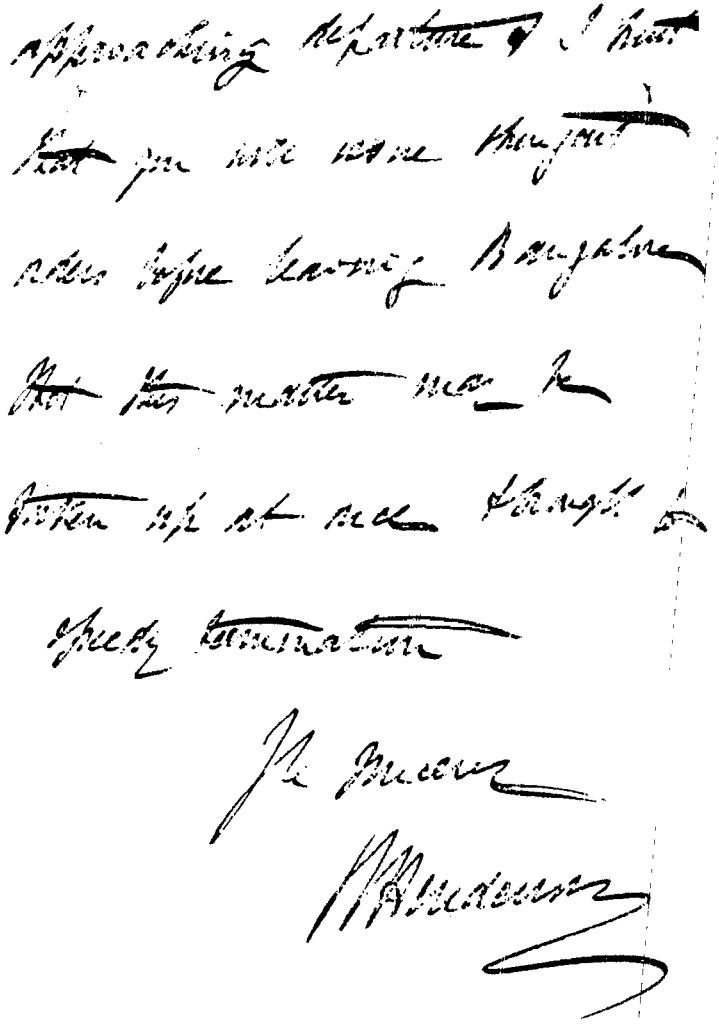
My dear Sir

During the D.P.W. Secty's absence there has been I regret, some delay in the issue of instructions to Mr. Krishnayar. These have now issued & Mr. Krishnayar will at once see major travel.

Yrs sincerely
Sd/ K. Shankar Lingam Esqr

THE RESIDENCY
MYSORE





(General Serial No. 31.)

1893.

From

To

Dated

Despatched

Received

Enclosures No.

General No. 3709

No. 879

Sir,

I have the honour by desire of the Viceroy, to request that you will be good enough to cause land on Bright Road No 5, the Bayt Bungalow Nine Sayes Sir, to become absolutely applying the Land required in the Municipal valley for the main Road of the Bungalow and a half Street — you will then proceed to the sale of the necessary land by auction with such speed as may be needed by Legal forms, and you will on the accompanying Plan, the Land to be acquired.

agenda and prepare the usual explanatory statement.

The next meeting will be held on Wednesday 21st January at 7pm.

(17)

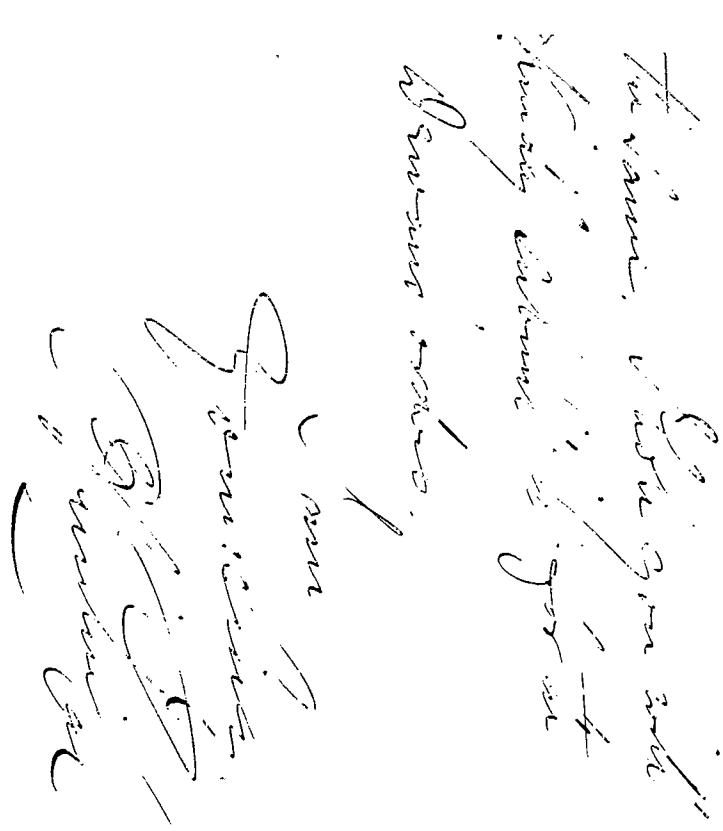
(18)

Samara
13 Dec 1919

Dear Sir,

Samara has received
[illegible] from a [illegible]
a [illegible] [illegible]
in [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] for
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]

Vice
Refer
No 10172-3
6/1/94



Sincerely as formerly -
The Secretary then retired
Requested to bear that he
will take the sense of Council
by circulation - Mr Blackburn
the Clerk wrote the Amendment -
To the Secretary will be asked to bear the
cost of the Statue above named

Resolved 1887
Dec
11/9/91

28/12

17

Office of the Collector & Dist. Magte
on Official Duty
Bangalore Dated 23rd Decr
1893

Memorandum

Being personally directed by the Devan to submit my proposals for the entertainment of an extra Establishment for work in connection with the acquiring of lands houses &c for the Hagigal Water project, I beg to submit the following for favorable consideration and early orders.

Rao Saheb Anekolar Ramanna of Doddaballapur has already reported himself for work under me as directed in person. The above work as well as that in

Connection

connection with the distribution
of Compensation (non-Sanctioned)
for Lands to be acquired for the
Enlargement of the Kesarpuetta
Tank, is likely to keep him
Engaged up to the close of
March next. Unless his posi-
tion is defined the Comptroller
might object to pass his pay
bill and hence the necessity
for definite orders. As
Bangalore life is somewhat
expensive, I submit that during
his employment on Special duty
Shamanna may be allowed
to draw batta at Rs 1-8-0 per diem
in addition to drawing the
pay of the Last Class Amildar
viz Rs 100.

As Shamanna will
have much out-door work he
would

would require the use of a Sketching
Pali and the services of at least
two peons on Rs 6 each

I have managed to get
through the preliminary work
with the aid of my Establishment
but working out the details would
involve much clerical work. I
beg that sanction may be accorded
for the entertainment of two clerks
on Rs 20 and 25 respectively.

Yours
Sub Division Officer
on Special Duty

a higher rate of Compensation. Of
from the 192-7 acres belong to Iram
and Koyamgatta villages.

4. I have been able to personally
inspect all the lands and fix rat
Rs 50/- per acre as an average is by
no means an excessive rate of Com-
sation. Most of the ryots will be
deprived not only of their lands, b
most probably every inch of ground
they possess, and there is scarcely
any land since in their present
available for cultivation. This consider
tion will form an indispensable fac
in awarding Compensation.

5. I therefore estimate the Com
pensation for the lands alone at Rs 2,35
About Rs 2000/- will in addition ha
to be paid for trees in the mango an
Casuarina plantations, and the houses
&c in the villages required to be remov
are estimated to cost about Rs 2000/- m
more. Thus the Compensation payable to

ryots

ryots alone will come up to about
Rs 2,53,800.

6. From the statement it will be clear that the assessment of lands now in ryots holding is Rs 3+x-2-0. This added to the assessment of Government Ponzer lands namely Rs 2+6-5-0 will result in the total loss to Government of Rs 1,8,0+-2-0 annually. This if capitalized at 30 years purchase, will come up to Rs 4,08,20-12-0. It may be safely asserted that this is by no means extravagant, when consideration is paid to the fact that the present land assessment is liable to revision only 8 years hence as the Taluk was settled in 1872. In all probability an enhancement of assessment would be made if the tract under notice is then resettled.

7. Now the aggregate compensation for the lands required for the project would come up to Rs 4,10,23-12-0

or

or in round figures to 4 lacs. No account is however taken of the value of lands and trees standing on the said Government Banjar lands which will have to be separately appraised. I am now taking measures to ascertain the same and shall be prepared to submit the information by and by if called for.

8. In case the Government decides upon acquiring the lands and removing the villages, the villagers will further require a reasonable time, say about the end of January next of the lands as may be immediately necessary for the execution of the works will of course be made available at once.

9. The tracing received with your letter is herewith returned, the portion proposed to be acquired being

being marked by blue border.

I have the honor to be,
Sir,
Your most obedient servant
J. Hutchison
Sub Division officer
on special duty.

(General Serial No. 50.)

1893 No. 10188

From

To

The Chief Secretary to the
Dewan of Mysore.

Dated

Despatched

Received

Enclosures No.

General No.
No.

References to be marked.

Mysore Govt. C. Press, Bangalore.—30-6-92—3000.

d assessment of the lands
Maligat Irrigation Project.

Circar Bungaro															Grand Total			
Dry		Wet			Garden			Total										
Area		Extent		Assessment	Extent		Assessment	Extent			Assessment				Extent		Assessment	
2	8							43	9	22	5				102	1	67	5
4						8	3	8	22	35	97	8			44	86	36	14
75	8								742	80	75	8			996	32	636	4
1					3	25	57	12	27	20	57	12			220	20	153	4
7	12								186	26	47	12			655	32	411	10
1									72	4	27				685	3	332	12
31	2	1	14	3	8				579	26	234	10			1516	22	914	2
5	12								247	3	116	12			379	5	268	12
1	8								85		6	8			864	22	558	
5	8								97	8	46	8			259	29	214	2
1	4								113	12	79	14			324	28	348	2
	6								3	35	3	6			3	35	3	6
	2								27	20	29	12			27	20	29	12
		1	14	3	8	4	6	53	4	2397	20	1446	6		5482	16	2667	14
															16	6	16	4
															90	5	124	
															83	21	83	8
															2	15	2	8
															192	7	226	4
															5674	23	4894	2

572

Sub Division Officer
on special duty

SECRETARY'S OFFICE
REG'D. NO. 3 JAN 94
MYSORE VIDHANA

Statement showing the [illegible] proposed to be [illegible]

20/a

Reports Retdings

Special Number	Village	Dry				Wet				Garden				Total			
		Extent		Assessment		Extent		Assessment		Extent		Assessment		Extent		Assessment	
1	Mattakulli	58	32	44	4	.	.	.	.	.	.	.	.	58	32	44	4
2	Maligal	217	4	226	6	5	25	21	12	3	32	24	4	226	21	272	6
3	Nagamballi	247	1	339	8	1	13	20	4	.	.	.	.	254	14	359	12
4	Siddalaya	191	31	84	12	.	.	.	.	1	6	10	12	93	1	95	8
5	Sanaguruvanahalli N	462	26	333	.	4	12	15	14	1	38	15	.	468	36	363	14
6	Sreegandada N Kaval	610	22	302	12	.	.	.	.	.	17	3	.	610	39	305	12
7	Suggere N	925	2	615	12	6	10	20	8	5	24	43	4	936	36	679	8
8	Kattamaranahalli	131	15	145	.	.	.	.	.	.	17	7	.	131	32	152	.
9	Varakhanda Kaval N	829	3	500	.	.	.	.	.	1	19	12	.	829	22	512	.
10	Yesowanchpur N	161	24	165	10	.	37	2	.	.	.	.	.	162	21	167	10
11	Peenya N	211	10	268	4	.	.	.	.	.	.	.	.	211	16	268	4
12	Chockasandra N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
13	Nayandhalli	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Total	4035	16	3025	14	24	17	80	6	14	37	115	4	4084	30	3221	8
	Agrahara Devanahalli N.S.	.	.	.	.	.	.	.	.	.	.	.	.	16	6	16	4
	Todi Kempapur N.S.													90	5	124	.
	Yeggenahalli N													83	2	83	8
	Nallakadaranahalli N													2	15	2	8
												Total		192	7	226	4
														4276	37	3447	12

Office of the Sub Division officer on special duty in Connection with Irrigation Work

19
8/11

Read:-

Memorandum dated the 23rd December 1893, from Mr. K.G. Hutchinson, Sub-Division Officer on special duty in connection with the Hiranyakatta Water-supply project submitting for sanction ~~the Inaugurality noted~~ proposals for the ~~Establishment~~ Staff of the Establishment in connection with the acquiring of lands, ~~Concerts~~ for the Municipal Water project and requesting that Rhamanna, the Acting Amildar of Dodaballapur who has reported himself for duty under him may be allowed to draw the pay of the last grade Amildar and ~~batta~~ Batta at 1-8-0 per diem and the use of a sleeping pall.

Order

Order no 10172-3 / 2197 dt 1-1-94

Division is attended to by Mamlatdar Camp Bellary 3 times a week Rs 100 per mensem (Rs 1½ per day) His Head Quarters will be Bangalore and he will draw batta at Rs 1½ per diem while absent on duty from Hd Quarters, subject to the rules of the Travelling Allowance Code. A tent is considered unnecessary as no tent is supplied to Amildars. Two qualified clerks on Rs 20 & 25/- well versed in English and Canarese may be entertained by the Amildar as proposed

The work should be finished as quickly as possible. The Revenue

Acting Amildar Hiriyur to be directed to depute Sheristadar Huzur Circle Sheristadar to Hiriyur Camp in connection with the work in Hiriyur Taluq

8/12

(21)

Notification

Under the provisions of Section 6 of the Land Acquisition Act 1 of 1870, it is hereby declared that the lands described in the annexed Statement are needed for a Public purpose, viz., for constructing a Canal in connection with the Madgal Water Supply Project. (Acquisition & Reclamation)

By Order

28/12

24/12

Secretary

28/12/93

To be published in four successive issues of the Gazette.

4 situated in the Tsangpo Valley of the Assam Himalayas are

No. (1) 20B / R.1053 — 29-12-93 / 5/1/94

Land required for Public Purposes in the Assam Himalayas

Copies to Political Officers, Tawang & Tuensang

Copies to Political Officer, Tawang

A.C. 11060 / G.F. 332-92

Encls: 1 letter
1 state.

Regd. not available

814 (24)

817

To

The 1st Asst Resident in
Nyasa:

Sir, Lt. Cobbe's

Adverting to the D.O.
letter of 7 Nov 93, I
am directed to forward
herewith for the Resident's
information a Copy of a Report from
Lt. B.G. Kristensen, the
Sp. Officer deputed for
the acquisition of the
lands, houses &c required
for the Medical Water Supply
Project.

No 70 of 26 Dec 93

2 The Nyasa Govt have already published the declaration required under the Land Acquisition Act, and the settlement of Compensation in each individual case will be proceeded with at once. Through the ~~Govt~~ amount of Compensation

Eventually ~~actually~~
~~which may be~~ required to be
paid for the whole of the
lands to be acquired
Cannot ~~now be stated; before~~
~~the exact can be stated~~ now be
exactly stated, yet, the
Chairman of the Durban,
the sum of £4 has named
by Mr. Christiancy as appears
to be a reliable Estimate.

3 Any amount, which the
British Govt: may be able
to pay for the purpose
in the Current year, the
Durban will arrange to
receive & distribute to
the various claimants.

The remainder can be
paid in the next official year
from time to time as req^d

13. 1. 97

Thos Chilcott
14 January 97

G 28-1-94

Please register
at once & send with
file 23/1/94

No. 239 / 1893-94

8816

27

FROM,

THE FIRST ASSISTANT TO THE RESIDENT IN MYSORE.

No. 11306 / R2138

To

The Dewan of Mysore.

Dated Bangalore, 23rd January 1894.

SIR,

I have the honour to forward herewith a letter No. 11056 dated the 1st instant, from the Comptroller, Mysore, to this address, requesting the necessary orders of Government for the payment of the annual contribution of Rs. 1,50,000 to the Mysore Treasury, and for the transfer of Rs. 1,50,000 from the Mysore Treasury to the Bangalore Treasury, on account of the Mysore Contingent Charges for the current year.

2. In connection with the above, I am directed to state that the Government of India have been pleased to sanction the payment of the annual contribution of Rs. 1,50,000 to the Mysore Treasury, and the transfer of Rs. 1,50,000 from the Mysore Treasury to the Bangalore Treasury, on account of the Mysore Contingent Charges for the current year, and that the Resident has been requested to issue the necessary orders to the Comptroller, Mysore, and to the Treasury Officer, Bangalore, accordingly.

3. I am also directed to request that the annual contribution of Rupees one

au Règlement d'Ordre. 3,125 — 12 —

(2) Chapitre Additionnel

Frais Extraordinaires. 1,245 — 5 —

4,623 — 2 —

Capitaux à Engager pour Rente = 231,150 —

1,540 ! Au Lieu de 2 Engagements Additionnels

de Fr. 1,540 chacun, il n'en sera Réglé

Qu'un seul de Fr. 2,100 pour Egaler

Exactement Le Capital Réel Nécessaire

Au Service Régulier de la Rente,

Et. Attendu que le Règlement d'Ordre,

Qui n'Exécute Aucune Dépense Qui

Ne Soit Dans Ses Limites Réelles.

3. Attendu que le Principe

De Compensation Doit Régir Tous,

Sans Exception Aucune, Egalement

Tous les Intéressés, Mais Sans Accroissement

Pour Les Uns Des Charges Déjà Très-

Considérables Qui Pèsent Sur Les Autres

Et Non Justifiées Par Un Principe

De Compensation.

Veuillez Agréer, Monsieur,

L'Assurance de Ma Considération

Très Distinguée,

Votre Très Humble Serviteur,

Le Juge de Paix Cantonal

(417) (28)

No. 19 dated 24th January 1894

Resp. not available

To

The President in Council.

Sir,

I have the honour to acknowledge the receipt of your Office letter No. 232/18-94, dated 23rd January 1894 and in reply to state that, in the opinion of the Burdwan Commissioner to the State for the perpetual loss of its revenue from lands taken up for any water supply project is a most fair charge on such project. In the present case, the loss will be Rs 3447-12-0 per annum on Revenue not actually realized

And Rs 1445-6-a per
annum on revenue in
prospect in respect
of lands now waste.
I beg to add that these
waste lands now
bring a small revenue
from the annual sale
of the pasturage on
them, and that, judging
from the general ex-
pansion of cultiva-
tion in recent years,
the Durbar have every
reason to believe
that in the near future
they will all be taken
up for cultivation
and begin to con-
tribute their full
share to the land

Revenue of the State

2. With reference to the remark that the item of Compensation in question "has never been referred to or anticipated", I beg to submit that the Dunbar can scarcely be held accountable for the omission.

I have &c

H. Deane.

Send Copy of this & of letter to which it is a reply to Col. Grant for info., & for any remarks he may wish to make, & the Minister of Marine & Fisheries in the Res. Council, has ref. to any info. furnished by him to the Resd.

26-1-94

hunted at & incorrect

Vide Order 27-1-94

N° A

Reçu non accordable

1. Lettre N° 238 A. 2 Bat. Sap. en date du 8 Août 1871 relative à un reçu à donner à M. Pasquet.

2. Lettre N° 240 A. 2e Bat. Sap. en date du 9 Août 1871 relative à un reçu à donner à M. Pasquet.

Paris le 27e Août 71

(29)

Le Chef d'Escadron,
Chef de l'Etat Major

Sir,

J'ai l'honneur de prévenir
Votre Excellence que les
travaux dirigés par les Officiers
du Génie sur la Rive droite
de la Seine ont été
exécutés par M. Pasquet, qui
l'a fait exécuter par
des Ouvriers civils et
aux Salaires fixés de
Commun accord entre eux
et les Officiers du Génie
chargés de la Surveillance
de ces travaux. Ces
Salaires ont été
Communiqués, Sir, à
l'Ingénieur en Chef

(420)

No 12254
G.F. 332-92
29-1-94

(31)

To
The Commissioner
Sir Edward Clery.

Sir,

With reference to your letter No 8225 dated 20th December 1893, requesting me to ~~[illegible]~~ to forward to the Magistrate's Court, Ridgeway, the Depositions, Exhibits and Recognizances in the case of Regina against Ahmed Ali, I have the honour to forward herewith copy of letter No 11055 dated 13th instant, addressed to the Sub-Inspector of the Police.

I have the
29/1/94
Secretary

(General Serial No. 31.)

189

From

To

Dated

Despatched

Received

Enclosures No.

General No.

No.

No 488

32

821

Survey Department Office

Bangalore 3rd February 1894

To,

The Acting Secretary to the

Board of Health

Sir,

I have the honor to acknowledge the receipt of your letter Dy. No. 29 of the January 1894 forwarding copies of correspondence regarding the compensation payable for the land taken up for the Chinapet Project for the water supply of the Civil and Military Station of Bangalore.

2. I am directed to state that to make any remarks on a certain omission

omission which it is suggested in

letter cyc 239 dated 23rd January 1894 from the Executive Resident to the Dewan may have occurred in the amount named by me as the probable contribution charges in connection with the Project in question. The information now given to me in the copies of correspondence forwarded with your letter under reply does not enable me to understand fully the question at issue. My statement, pending the calculation of what would have been the yield

5 No 27

Where is this?

to the Right of compensation not
what would have to be paid by
the United to the Citizen Govern-
ment for loss of revenue & the
latter calculation could easily
be made on my figures of
area and assessment. That my
estimate did not contain such
calculation in no way affects
the question at issue. I did not
even know whether the scheme
was a joint one of the two Gov-
ernments or not. I think this
item could not be the subject
of suit that the Citizen Govern-
ment is entitled to compensation
for loss of its revenue. The
principle

principles and significance for
as my opinion is concerned, when
I made a calculation in connection
with the Official Census of Cost
to the Civilian Government of
water rates on the Rand under
the Rand Mint not within the
calculation proposed to be taken
up.

I have the honor to be
Sir,
Your most obedient Servant

Superintending Engineer
Rand

8122

(33)

No 13244
Ft 552-92 9/10-2-94
10

Com. de Transports & Tourisme
Secrétariat Général

Sous

Monsieur le Directeur
Général de l'Information
Touristique. J'ai l'honneur
de vous prier de bien vouloir
me faire connaître la suite
réservée à la demande
présentée par la Société
Nouvelle Hôtelière

Paris le 2-5-94

Copies
à Mme Nº A 27 Sous-Dir
pour info des Directions
Bureau Nº 488 3e Sous-Dir
pour info Bureau intéressé